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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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A Slight Recognition.

No matter from what angle regarded, the Leicester Conference ranks as being one of the most successful ever held, whilst the outstanding feature, expected though it was, was the extraordinary interest taken in Captain Mortimer's Paper on "Recent Progress in Aluminium Castings." The new President, Mr. S. H. Russell, well deserves the honour accorded to him. He typifies the modern industrialist who appreciates and uses recent scientific developments to the limit of the capacity of his work's organisation. His presidential address gave one the impression that the suggestions he put forward were not talking points, but jumping-off grounds. Thus, we should not be surprised if, when he leaves the chair, the question of entrance to some grades of the Institute by examination is materially nearer.

The election of Mr. F. P. Wilson as a vice-president indicates that the 1930 convention will be held in the Cleveland area. Mr. Wilson, as the first president of the Middlesbrough section, succeeded in creating such a sound organisation that everybody is convinced that it can easily sustain the arduous duty of stageing an annual meeting.

The East Midland area possesses a group of very erudite and progressive foundry owners, who are to be congratulated on the enlightened outlook on the work accomplished by their representative technical association. They not only showed the visitors everything they could, but without exception entertained them most lavishly. At the British Thomson-Houston Works, at Rugby, Mr. Dumas referred to the substitution of castings by parts built up from steel sheets by welding, and warned the foundry industry of the necessity of reducing costs by drastic modernisation. Yet his own foundries are making intense efforts to keep up to date. Then again, it is difficult to envisage a more modern factory than Leys Malleable Casting Company, where batteries of sandslingers tow in their wake stripping machines, and thus count their production of castings in millions. At Stanton, modernisation is in progress. Mr. E. J. Fox stated that the coke consumption in their cupola practice had been reduced to less than 7 per cent. The blast furnaces, too, work on an equally economic basis. The L.M.S. Railway foundry, too, is a model worthy of emulation by others similarly engaged. The visit to the Rolls-Royce concern showed engineering precision brought to the highest state of perfection, whilst the Herbert Morris works provided a working exhibit of handling tackle which represents machinery of an essential character for the prosecution of foundry processes under rational conditions. The products of John Taylor & Company, as a specialised bell foundry, are universally known and appreciated; whilst the patternshop machinery made by Wadkin & Company is found in most modern plants, and it was a happy thought to permit users to visit their works and examine their methods of production. To all these firms the foundry industry is deeply indebted, as well as to those who opened their doors to the visitors' ladies.

The Papers presented were of more than usual interest. On the ferrous side, that by Messrs. Evans and Peace was unusually comprehensive, whilst that from Mr. Lamoureux was extremely interesting on account of its controversial nature. The costing Paper by Mr. Wintle suffered a little because of pressure of time not allowing adequate discussion. The striking absence of members connected with steel foundries minimised the discussion on Mr. Hall's Paper and thus Sir Robert Hadfield's written communication was especially appreciated.

Finally, on behalf of the foundry industry, we tender our sincere thanks to the Leicester Civic Authorities, the Convention Executive Committee, and to everybody who, by money or personal service, contributed to this splendidly successful convention—both social and educational.

Cupola Coke.

Cupola coke, which is of enormous importance to the ironfounding industry, has received its due share of the recently awakened interest in fuel. Considerable thought and technical skill have been devoted in the past to the design and operation of coking plants, for cheapening rather than improving coke. The properties of coke required for particular applications, and its closer approximation to varying requirements, have received little attention, and on this subject little appears to be known and less available. Individual coke users, such as cupola owners, have ideas of their own in these matters, but such ideas arise almost wholly from first-hand experience, and are not as yet capable of expression in precise scientific terms, for the tests hitherto applied to coke have been mainly those of visual examination and practical trial.

The characteristics of cupola coke are determined not only by the coal from which it is made but by the actual conditions under which coking is conducted, such as the size and shape of the retort and the length of the coking period. For the proper purchase and use of coke it is highly desirable that some tests should be defined which any user could carry out.

Considerable work is, however, involved in determining tests whose results can be relied on to agree with those afforded in practical working, for a variety of tests must be carried out on various cokes to determine which can be correlated most satisfactorily with practical experience. The correlation, moreover, must be definite enough to convince both the user that he is safe in employing the tests as criteria in purchasing and using coke, and the maker that the results discriminate fairly between cokes made from varying coals in different plants.

The setting up of Coke Research Committees in various areas therefore represents an important step forward. Their main object is to find tests which will give results in accordance with practical experience, but which can at the same time be carried out at much less cost in time and money than an actual service trial. Two such committees, representing both makers and users, have been functioning for some time. The Midland Coke Research Committee is centred in Sheffield, and the Northern Coke Research Committee in Newcastle, the necessary work in each case being carried out at the local university. A further committee is under contemplation for Scotland. These committees are concerned, of course, with blast-furnace as well as cupola coke.

The nature of the coke made in a particular area is necessarily closely related to the coal available. Hence cokes coming from different districts, like pig-irons, possess definite characteristics which are well recognised in the trade. The policy of forming territorial committees has, therefore, considerable justification apart from the question of national co-ordination.

XUM

An important part in the work is being played by the Cast-Iron Research Association, which is co-operating, where cupola coke is concerned, with each committee, and thus avoiding duplication and overlapping of effort.

The more fundamental work of the Fuel Research Station at Greenwich, together with the activities of these local committees, should provide a basis for progress that is bound to be of considerable value to the industry, and further developments will be awaited with interest.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Where to Start?

To the Editor of The Foundry Trade Journal.

Sir,—With reference to my letter written in reply to your editorial of June 7, there is a mistake in the line 18 from the finish. It should read—"I wish to state again, this Paper was *not* written, etc." Trusting you will make this clear in your next issue.

Yours, etc.,
John Shaw.

The Brightside Foundry and Engineering Company, Limited,
Newhall Iron and Engineering Works,
Sheffield.

June 15, 1928.

Aluminium Alloy of Standard Analysis.

To the Editor of The Foundry Trade Journal.

Sir,—Re Capt. Mortimer's Paper at the Leicester Conference on Aluminium Casting Alloys: During the course of the discussion it was mentioned that difficulties had arisen due to discrepancies of analysis between chemists. May we take this opportunity of mentioning that the British Chemical Standards movement has foreseen this difficulty and taken a step which should help appreciably to overcome it? It has prepared a standard sample of aluminium alloy which has been carefully analysed by a number of experienced analysts; and this sample will shortly be issued. Chemists making use of this standard sample may thereby compare their working and methods of analysis with those who have analytically standardised the sample, and this will no doubt eliminate many differences and tend to co-ordinate results.

In steel and cast iron it is, of course, common practice for chemists to run concurrent tests of standard samples along with their routine tests, and a similar practice is now being made possible with non-ferrous alloys, though only one or two are available at present.

Yours, etc.
C. H. Ridsdale and N. A. Ridsdale,
Joint Organisers.

British Chemical Standards,
Organising Headquarters,
3, Wilson Street, Middlesbrough.
June 14, 1928.

Iron Making in the Middle Ages.

To the Editor of The Foundry Trade Journal.

Sir,—My attention has just been called to the article on "Mediæval Founding" in your issue for February 23 last. As I have made a close study of the account roll of the old ironworks at Byrkenott, near Bedburn, County of Durham, I am in a position to supply some information supplementary to that given by Mr. Littlehales.

The Durham County Roll distinctly states that each bloom weighed 15 stone and each stone 13 lbs.; this would make the weight of a bloom 195 lbs., as "considered" by Mr. Giuseppi in the "Archæologia."

There is ample evidence that at Byrkenott water power was used. There are entries of payments made to Thomas Gylle, the carpenter, for making a water wheel (*unam rotam aquaticam*) and for the carriage of an "axeltre" for the hanging wheel (*rotam pendentem*). But it is not quite clear for what purpose the water power was used, whether to work a heavy forge hammer or the bellows for producing the blast. The same Thomas Gylle received also payment for making "les belowes"), and the wooden "spowtes" leading from the watergate to the wheel. No mention is made of a large forging hammer in the accounts.

John Gylle, the "smythman or blomer," attempted to make iron during the week ended November 24, 1408, but failed. For the previous week there is an entry of payment to one William Aycle for expenses in going to Wakefield and Rotherham for blomers and colliers (charcoal burners) for the new forge. John, however, managed to make six blooms during the week ended December 1, for which he received 3s. Only three blooms were produced the following week, as the bellows were broken, but new ropes were obtained for the bellows during the week ended December 15. During the 153 days (June 12, 1408 to November 11, 1409) 278 blooms were made, weighing altogether 4,164 stone, which also gives the average weight of a bloom as nearly as possible as 15 stone, or 195 lbs.

The reason why one hesitates to accept the notion that the water power was used for working the bellows is that there are numerous entries of payment to the wife of John Gylle for working the bellows. On the other hand, there were weeks during which blooms were made without Mrs. John or anyone else receiving payment for working the bellows.

The "toyers" mentioned in your article were probably "towirons." Carrying one of these to West Aukland just before Christmas cost one penny. Probably they were tools for handling lumps of hot iron.

An interesting entry is a payment of 8s. (twelve days at 8d.) for carrying cinders from Hopyland Park to the forge for tempering (*temperando*) the "new iron" made.

There were two women employed at the forge, namely, Mrs. John Gylle, who, besides operating at the bellows, broke and screened stones (ironstone) and worked at the "bloomhearth"; and the wife of Thomas Whenfell, the foreman, who occasionally worked at the "stryngheareth," her husband helping John Logge, who made iron and cut it in pieces for further treatment.

There was another forge at Blakamore, which the same John Gylle and Thomas Chyld went to see before they had started building the new forge at Byrkenott.

These data do not exhaust all the interesting matter contained in the account roll.—Yours, etc.,
Historian.

Electricity in the Modern Foundry.

Dynamic Braking Controllers for Crane Hoists.

One of the improvements introduced in recent years in connection with foundry-crane operation is the use of dynamic-braking controllers for use in connection with series wound crane motors where the lowering speed is to be controlled by dynamic or electric braking. This can be done when the mechanism permits the load to drive the motor, when lowering, thus causing the motor to generate and serve as a variable braking device.

The latest type of controller for this service, which has only just been placed on the market, is for direct current service with motors up to 50 h.p. at 440/550 volts. Above this size contactor control is usually recommended. These new controllers, which have been designed by the British Thomson-Houston Company, are of the drum-type having a rigid and open construction with large and accessible cable space. The cables are connected to terminals forming an integral part of the extruded metal fingers, and each finger can be detached or adjusted from the front of the controller. A large cable inlet is provided in the base to which pipe connections may be fitted, or the back can be drilled for cable fittings.

A two-finger interlock can be fitted to controllers of this type for electrically interlocking them with a circuit breaker so as to prevent the motor being switched on to the line before the cylinder has been returned to the off-position. As an alternative a four-finger interlock can be fitted which combines the off position interlock with contacts for use with an auxiliary current limit switch.

From speed-torque curves it is seen that low speeds as well as high speeds are available for all loads, higher speeds being attained when lowering than when hoisting. Generally speaking, the maximum speed when lowering is about twice the normal hoisting speed. For hoisting plain series-resistance control is used, as in ordinary crane service. Diverter, sometimes known as potentiometer, control is used for lowering, thus giving the effect of a shunt characteristic to the motor.

The sketch shows a simplified diagram of connections of the new B.T.H. controller, from which it will be seen that the resistance, series brake solenoid and series field are connected in series across the line whilst lowering, and that the armature, with a braking resistance in series with it, is connected in parallel with a portion of this circuit. A movement of the controller cylinder from the off position increases both the voltage across the armature and the speed of the motor.

Under ordinary working conditions, when lowering, the load on the hook will determine whether power is to be supplied to drive a light hook downward, or dynamic braking applied to check the

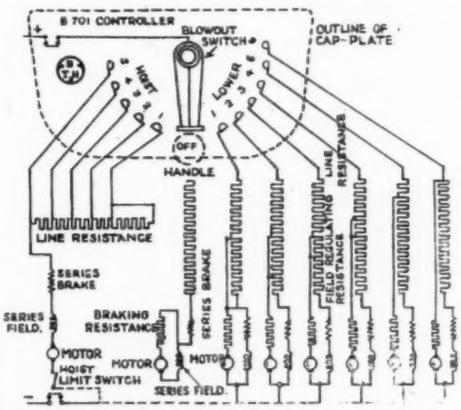


Fig. 1.—Connections Diagram for the New B.T.H. Controller.

speed of a heavy load. In the latter case the motor would generate and send current round a closed circuit, as shown in the diagram, thereby loading the motor and producing a braking effect.

The heavier the load, the greater the armature E.M.F. and field strength will be. This produces a braking action which rapidly increases with the speed, until the torque exerted by the load and the braking effect of the motor are counterbalanced.

The dynamic braking type of controller gives complete control of the load when lowering, as well as when hoisting. If the supply current should fail when lowering a load heavy enough to overcome the crane mechanism, the load can still be lowered under perfect control as the motor acts as a self-excited series generator. This is a valuable feature of electric braking control.

Further, a Weston type of brake is not required with these controllers. If a mechanical brake is existing, it should be put out of action, as this type of brake cannot be used with this method of control.

Reference to the connections at the off position will show that, in moving from the first point lowering to the off position, a closed circuit is still retained for the armature and field, external to the series solenoid brake, so that the motor is still acting as a brake for retarding the load. This saves wear on the solenoid brake, which is only used for finally bringing the load to rest.

These controllers are suitable for use with series wound brake solenoids; the latter should be designed to lift at 40 per cent. of full load current. It should be remembered, however, that in all cases in which it is desired to use shunt solenoids with dynamic braking controllers should be made the subject of a special investigation and inquiry.

The North British Locomotive Company, Limited, have secured an order for 50 side-tank locomotives for the Great Western Railway.

The Cohesibility of Rammed Sand.*

By Ivan Lamoureux (President of the Liege-Limbourg-Luxembourg Section of the Association Technique de Fonderie of Belgium).

[BELGIAN EXCHANGE PAPER.]

Sand in Nature.

When medium sand as taken from the quarry is examined it is found that it has scarcely any power of cohesion. It is very difficult to make it into a lump possessing any consistence. This is due to the fact that the grains of silica are bound together not by a uniform mass but by small colonies of argillaceous matter, so that the grains touch each other at their angles, leaving the natural binding material between them (see Fig. 1).

The Treatment of Sand.

The precise object of treating sand is to distribute the clayey matter in a perfectly regular manner throughout the sand. By treatment in the mill—that is by rubbing the sand—each grain of silica is encased in clayey matter and the sand becomes plastic, thus acquiring its real binding property (see Fig. 2). The object of the work of the aerator is to give the sand greater porosity and to increase its permeability.

In order to observe the effect of the treatment of the sand it is enough to rub it between one's fingers for a few moments. It will be found that sand which is apparently weak at once becomes very strong.

Ramming the Sand.

When sand is pressed on a flat surface the grains arrange themselves according to one of their largest faces, the clay matter is pushed between the grains and the whole forms a very smooth surface. This is why flat castings and horizontal surfaces generally have a very smooth appearance (see Fig. 3).

The ramming of the vertical walls, however, produces a sort of tearing apart of the grains, inasmuch as the grains of sand, being angular, adhere to the walls and turn round several times. When the ramming is finished, the surface instead of being perfectly smooth is actually rough, and it is for this reason that the vertical parts of a mould are generally less presentable and smooth than the horizontal parts (see Fig. 4). Whatever be the method of ramming adopted—by hand, machine squeezing, jarring or slinging—the sand of the vertical walls will be rougher owing to the friction of the grains. It is therefore desirable to devise an arrangement for lateral ramming which will push the sand against the pattern.

It is very desirable, therefore, to give all patterns as large a taper as possible. It is quite certain that the founder will make no objection and that the castings will be much better in appearance.

Moulding Without Patterns.

Strickling.—In sweep moulding, a board with the requisite section cut bevelled (see Fig. 5) is generally used. This board cuts the rammed sand and causes a superficial tearing away which has to be remedied by pressing the sand with the points of the fingers and making several passes with the sweep. This work necessitates smoothing with tools (see Fig. 6). When the castings are dry-sand moulded the moulds are relatively sound, but in green-sand moulding, scabs or blisters are frequently found. This is due to the fact that the rammed sand has been impaired, its cohesion has been affected, and none of the methods of restoring it has proved effective. In America, for most cylindrical castings, instead of a bevelled board it is customary to use a portion of the pattern fixed to the spindle arm, against which the pattern sand is rammed (see Fig. 7).

As soon as one portion of the mould is finished the portion of the pattern is removed and the ramming is continued until the whole mould is finished. In this way castings with very smooth surfaces are obtained, as the sand has retained its cohesion and permeability, which are always endangered by the action of the sweeping board and tools. The same method is followed for the inside and outside of the mould.

Moulding With Gauges and Templates.

When castings of uniform section have to be made without patterns, such as those of machine tools, bed-plates and frames of various types, it is customary to sweep the mould by means of wooden gauges on which templates are made to slide so as to determine the dimensions of the casting (see Fig. 8). In this case also the founder will do well to employ the portion of a pattern, which

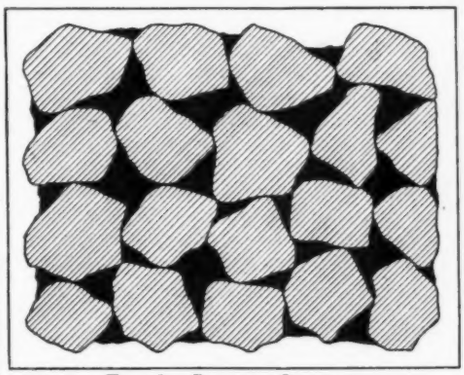


FIG. 1.—SAND AS QUARRIED.

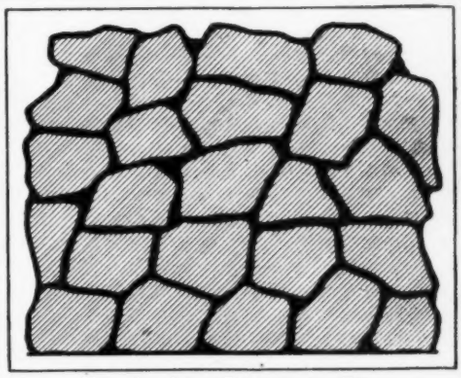


FIG. 3.—SAND RAMMED ON FLAT.

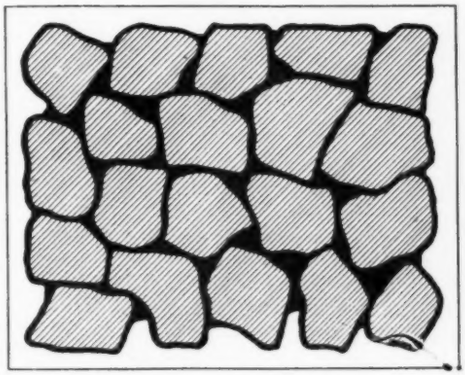


FIG 2.—SAND AFTER PREPARING.

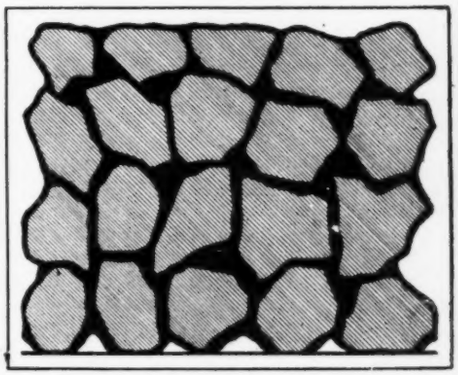
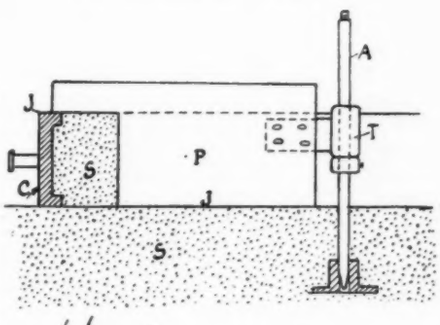
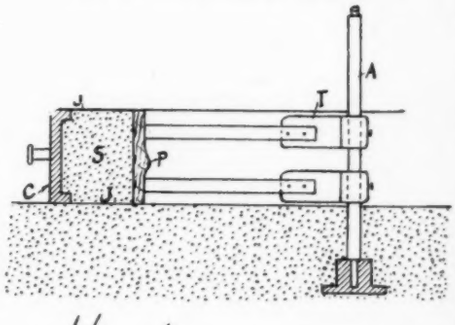


FIG. 4.—SAND RAMMED VERTICALLY.





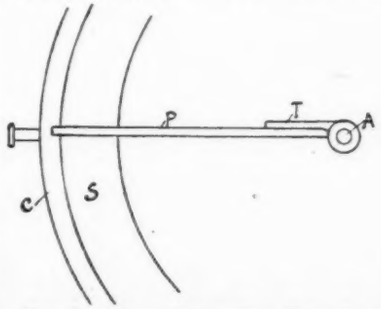


FIG. 6.—J = JOINT; C = BOX; S = SAND; P = SWEEPING BOARD; T = SPINDLE ARMS; AND A = SPINDLE.

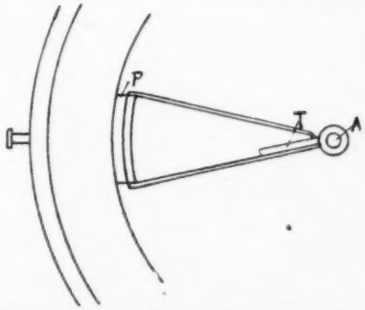


FIG. 7.—J = JOINT; C = BOX; S = SAND; P = A SECTION OF THE PATTERN; T = SPINDLE ARMS; AND A = SPINDLE.

* A Paper read at the Leicester Convention of the Institute of British Foundrymen.

can be removed as often as necessary. When the direct ramming of the walls has been effected the appearance of the casting will be very smooth and the mould will be perfectly sound (see Fig. 9).

Runners.

While much attention has been paid to the characteristics of the mould, too little regard has often been paid to the runner. The runner receives the molten metal and carries it to the interior of the mould. It is therefore subject to much more severe strains than the mould itself. If it is not perfectly resistant or if scabs are produced in it, all the sand dislodged will be carried into the mould and may spoil the casting. A cylindrical section is best because the release of the gases is effected by channels which are multiplied in number in proportion to their distance from the centre. It has been observed, on the other hand, that runners of prismatic form frequently showed scabs caused by the passage of the metal. When the runner is widened or flared with tools its surfaces are roughened owing to the disturbance of the grains (see Fig. 10). This defect will be demonstrated by using gates, the impression of which has been formed with tools. On the other hand, if the gate has been pressed or rammed by means of a pattern exactly reproducing its form, it will be noticed that the runner on the casting is perfectly smooth and that the down gate has consequently suffered no alteration (see Fig. 11).

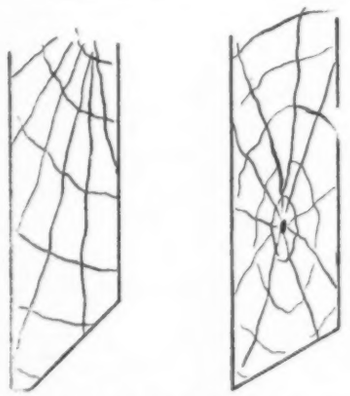


Fig. 5.—Shapes of Sweeping Boards.

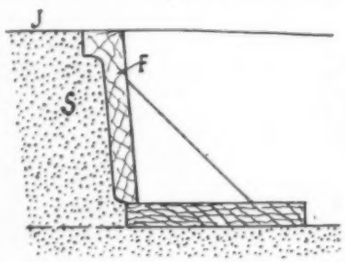


Fig. 9.—S = Sand; F = A Section of the Pattern; and J = Joint.

Fig. 10.

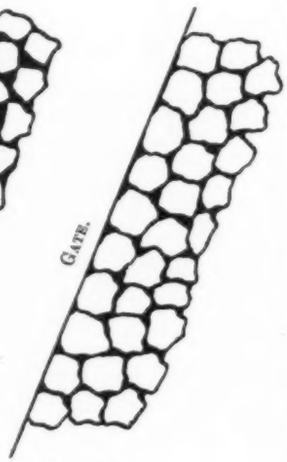


Fig. 11.

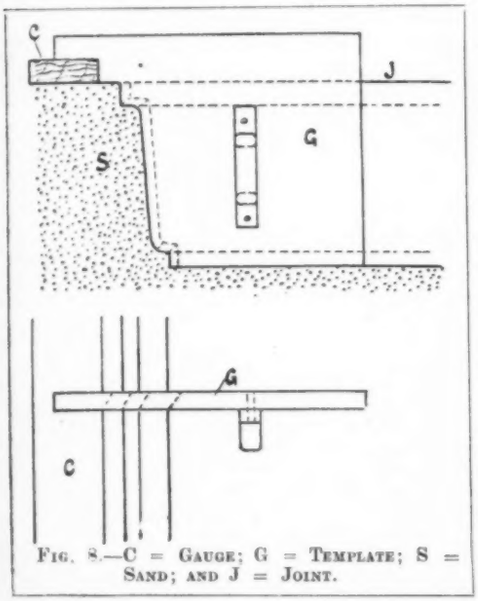


Fig. 8.—C = Gauge; G = Template; S = Sand; and J = Joint.

Conclusion.

In all the parts of the mould, from the runner to the riser, everything should be done to leave the mould in the condition in which it was rammed. Everything possible should be done to avoid retouching and mending. In short care should be taken to maintain its cohesibility unimpaired.

Tyneside Foundry to Extend.

E. N. Mackley & Company, Hawks Road, Gateshead-on-Tyne, are engaged upon important additions to their works, extensions, in fact, which will really constitute an entirely new works so far as the main shops are concerned; the existing works will form auxiliaries thereto. The Company purchased the whole of the buildings formerly in the occupation of Smith's Dock Company, Limited, South Shields, this Company having centralised their works at North Shields.

To accommodate the new buildings at Gateshead a considerable area of the available land has been levelled. This will accommodate an extension to the foundry by an additional bay 140 ft. by 70 ft.; a patternshop, the erection of which is nearing completion, is 70 ft. by 70 ft., with pattern stores above, and beyond this the timber yard.

The main building, 160 ft. by 160 ft., comprising five bays, will be laid out for a machine and erecting shop. The existing machine and erecting shop will be laid off entirely as a test house. The whole of the shops will be connected with trolley ways, and roads will extend completely round the works. New offices are to be erected fronting on to Hawks Road.

Random Shots.

It is interesting to note how much space has been given of late in various sections of the Press to the question of holiday costs and attractions at home and abroad. One paper publishes a number of laments on the high prices charged by seaside landladies for furnished apartments—which, it must be confessed, did not strike "Marksman" as outrageous. Another gives space to a request for advice as to the possibilities of a fortnight's holiday abroad for two people for £25. While quite a number have discussed the recent suggestion that our typists go abroad in order to send home picture postcards with a large "X" and a legend "this is our hotel, and 'X' is our bedroom window!"

* * *

Snobbery or no snobbery, however, the taste for Continental holidays is growing every year, and I for one do not regret it—although in my heart of hearts I lament the incursion of the mob into regions where the Englishman was still a comparatively rare bird a short time ago. For there is no doubt that the Continental holiday offers better value for money, and if the only way to awake our native "hôtelliers" to the fact by neglecting them, then go ahead with the neglect!

* * *

If I am asked to specify the superior merits of the French and Belgian seaside resorts over our own, I can only say that, first and foremost, they know their job there. Have we not all suffered from the landlady who makes it a favour to provide indifferent accommodation at huge prices, and accompanied by endless restrictions? Have we not reflected that we do after all represent her livelihood, and it would seem only business-like in her to welcome us? And do we not all appreciate the difference when we go abroad and are met by a smiling and considerate individual who makes us feel that he is honoured by our presence, and that the gratification of our slightest whim is the very reason of his existence? That, in a nutshell, is the difference. I have found more pleasure in a holiday spent at a third-rate hotel abroad, where I have been made genuinely welcome, than in a first-class English hotel, where I have been treated with lofty condescension. . . .

* * *

There are, of course, such further advantages as the cooking, which is not only better but less perfunctory; the existence of cafés where music and dancing can be obtained for the price of a drink; the absence of out-of-date bathing regulations, and so on. For the advantages of climate I am not unjust enough to blame either our seaside town councillors or our hotel proprietors; but I am afraid it is a factor that can hardly fail to carry weight.

* * *

Arising out of my recent Aberdeen story, I heard this one, also with a medical flavour, but intended for the golfers among you. An enthusiastic but inexpert golfer was taken ill, and the doctor began by taking his temperature. The medical man looked grave. "102," he said. "Good Lord!" the patient exclaimed, "what's bogey for the course?"

* * *

Mrs. Malaprop is not yet dead. Her latest appearance, according to a contemporary, was in Athens, in the person of a lady visitor. She was shown all the sights at great length, and expressed herself as delighted. The tour finished at the Acropolis, and the guide asked if there were anything further she would like to see. "Why, yes," said the lady, "if it's at all possible I'd like to see those Four Horsemen there's been so much talk about!"

* * *

It is understood that the latest economy in Aberdeen is the utilisation of Lux when frying the bacon, the which modern Scotch extravagance is now permitting to follow an ample ration of porridge.

Marksman.

INSTITUTE OF BRITISH FOUNDRYMEN.

TWENTY-FIFTH ANNUAL CONVENTION.

The twenty-fifth annual meeting and conference of the Institute of British Foundrymen was held in Leicester from Tuesday, June 12, to Friday, June 15, under the presidency of Mr. S. H. Russell.

There were present more than 300 members and visitors. An admirable programme had been arranged for their instruction and entertainment, which included the reading and discussion of Papers, visits to works, and social functions. As usual, a charming feature of the conference was the admirable manner in which the varied interests of the ladies were catered for.

TUESDAY, JUNE 12.

On Tuesday evening the members and visitors enjoyed the hospitality of the Mayor and Mayoress of Leicester (Alderman and Mrs. J. Thomas) at the De Montfort Hall, Leicester, taking the opportunity of recalling old friendships and making fresh ones. Some excellent dancing and music were special attractions in a most enjoyable evening, which was cordially appreciated by all present.

WEDNESDAY, JUNE 13.

The Conference was held at the Y.M.C.A. Hall, London Road, and the members gathered there early on Wednesday morning, when the Lord Mayor (Alderman J. Thomas) accorded the delegates a civic welcome.

Civic Welcome.

THE MAYOR, in welcoming the delegates, said that it gave him the greatest possible pleasure to extend to them a very warm and hearty welcome to the ancient city of Leicester. He certainly hoped that their visit would be an enjoyable one, and that their deliberations would not only be to their satisfaction but interesting to them all. They would be considering subjects of a very technical character. The main object of such conferences, especially in an Association like theirs, was that they should get into touch with members from different parts of the country, and by means of these gatherings they would be able to compare notes with each other, and so come to conclusions with regard to certain methods in their special industry which must ultimately result in benefit to industry generally. (Applause.) From his knowledge of it, he considered their industry was one of the most important in the country. Without the ironfounders he did not know where the engineers would be. (Applause.) It would be impossible for the engineering business to be carried on as it was carried on without the assistance of the ironfounders. Arrangements had been made with the Tramways Committee of the city whereby all the delegates and their wives and lady friends might travel free on the tramcars and 'buses throughout the city. (Applause.) Leicester was a city 2,000 years ago, and had played a most important part in the making of the history of England. Amongst other ancient buildings, there was Leicester Castle, which was the Mother of Parliaments, because, in 1201, the then Earl of Leicester, convened a meeting of the Barons with a view to checking the excesses of King John, which resulted in the signing of Magna Carta at Runnymede 14 years afterwards. That was the reason that Leicester Castle was known as the birthplace of Magna Carta, and also the birthplace of Parliament. In 1265, it was Simon de Montfort, Earl of Leicester, who gave to the people of England representative government, when he asked the counties and towns to send representatives to Parliament. That was the original formation of Parliament in England. In the year 1300, there were two meetings of Parliament in Leicester, and, in 1414, there was another meeting of the English Parliament in Leicester, the reason assigned being that the air of Westminster was unsalubrious. (Hear, hear.) Speaking of Leicester as an industrial city, the Mayor said that Leicester was the busiest, the most prosperous, and the cleanest city in England. (Applause.) Unemployment was very rife in England generally, as they all knew, but he was very happy to be in a position to say that Leicester had a lower percentage of unemployment than any other city or town in England. (Cheers.) Unlike some other other towns, especially the northern towns, Leicester was not dependent on one or two industries, but there were a large number of industries available to afford employment to the people. When a town was dependent upon one or two industries, and those were industries as bad as the iron and steel and shipbuilding industries had been, every person in every household dependent on those industries suffered; but in Leicester there were so many industries, with many members of families engaged in them, that if one or two industries were in a bad way, there was still something coming into the family from those employed in the others. Socially, he always described Leicester as the hub and the queen of the Midland Counties. He did not think they would find another industrial city with a population round about a quarter of a million more like a garden city than Leicester. (Hear, hear.) They would find that Leicester enjoyed practically a real freedom from smoke; they could enjoy a clear, crystal sky. For an industrial centre they were very proud of that. (Applause.) Their working classes were well-dressed, well-shod, and well-conducted. They had some of the finest public parks in the country. Their freedom from crime was really wonderful. They might think that he was painting a very pretty picture of Leicester, but they were proud of Leicester, and he wanted them to go away not only with a good opinion of Leicester, but with an exalted opinion. He would only repeat, in conclusion, that it was a great pleasure to him to be there to extend to them the warmest and heartiest welcome possible.

MR. S. H. RUSSELL,
The recently elected President of the Institute of British Foundrymen.

Mr. Russell is a partner in the well-known firm of Messrs. S. Russell & Sons, ironfounders and engineers, of Leicester. This concern was established in 1864 by Mr. Russell's grandfather. He was educated at Wyggeston Grammar School, Leicester, and Birmingham University. He joined the Institute of British Foundrymen in 1908, and was honorary secretary for the Leicester Convention in 1914. It was largely through his efforts that the East Midlands Branch was formed. In 1923 he presided over this branch. He became actively associated with the British Cast Iron Research Association on its formation, and now serves on its Council. In 1926 Mr. Russell, when vice-president, together with Mr. John Cameron (a past-president), officially represented the Institute at the International Foundrymen's Convention held in Detroit City.

Vote of Thanks to Mayor.

MR. J. T. GOODWIN, M.B.E., M.I.Mech.E. (the retiring President), who occupied the chair during the early part of the proceedings, in responding on behalf of the Conference, said that when one considered the antiquity of Leicester one realised that there had been handed down in that city the *esprit de corps* which had carried the Corporation and its officials through troublous times, with the result that Leicester was one of the finest cities in England. They were indeed proud that the Mayor had welcomed them at their 25th Conference. Those who had inaugurated their Institute had had great forethought and foresight as to the future requirements of their particular branch of industry. They were not like unto the words of poor Cardinal Wolsey when he came to Leicester and wrote to the Abbot: "I have come to lay my weary bones with you"; but they were alive, and very much alive. (Hear, hear.) In the history of their Institution they had had many world-renowned men associated with them, and they revered their memory. Unfortunately, one of the strongest stalwarts of the Association (Mr. Oliver Stubbs) was away owing to a serious illness; otherwise, he was glad that many of their old members had stayed with them, including some of the original promoters of the Institute. They, together with others, had done good work, and had laid a strong foundation stone upon which they were building up an institution of which the country would be proud. (Applause.)

MR. WESLEY LAMBERT, F.I.C. (of London), in seconding the motion, in a few well-chosen words, pointed out that though there were something like 62 elementary metals in all, none of those metals was of any use in industry until it was foundered, so that the foundryman, apart from the engineer, did duty for almost every industry. He did not think that was generally recognised, but the time would come when the foundryman would come into his own, and the foundry industry would be recognised as one of the most prominent of basic industries. He had very great pleasure in seconding the vote of thanks to the Mayor for coming that morning, and for his kindness to them on the previous hearing. (Applause.)

The vote of thanks was carried with acclamation.

The MAYOR, in responding, thanked them for the warmth and cordiality with which they had received the vote, and added that that day was one of the days which would live in his memory for many years to come.

Annual General Meeting.

The business of the annual general meeting of the Institute was then proceeded with. The minutes of the last annual general meeting were taken as read, confirmed and signed.

The Secretary (Mr. T. Makemson) said messages of regret for non-attendance had been received from the following gentlemen:—M. Leon Thomas, President of the French Foundry Technical Association; M. Ramas, Hon. President of the same Association; M. Lamoureux, Vice-President of the Belgian Foundrymen's Association; Dr. Werner, President of the International Committee of Foundry Technical Associations; and Dr. Geilenkirchen, Director of the German Foundry Owners' Association. Messages of regret for non-attendance from their own members had been received from the following:—Messrs. Patterson, Little, R. W. Stubbs, Bayley, Christie, Wise, Sanderson, Roberts, Hay, Dawe, Starr, Bagshawe and Sommerfield.

MR. GOODWIN remarked that they deeply regretted the absence of their own members, and were greatly appreciative of the kind letters and

telegrams they had received from kindred Associations. He had had handed to him a cablegram from Cleveland from the Association in America saying:—"Officers, directors, members, take pleasure in extending cordial best wishes for successful Convention. Estep, Chairman, Committee International Relations." He knew they would wish him to reciprocate those good wishes, and he would do so at the very first opportunity. (Applause.) A second telegram read:—"President, Institute British Foundrymen, Association Hall, Leicester. Best wishes for successful Convention." That had been sent from Lowestoft by Mr. W. G. Hollinworth. (Applause.)

He thought he would be voicing their thoughts when he said they ought not to forget one of their absent friends whose serious illness had prevented

DELEGATES TO THE LEICESTER CONVENTION PHOTOGRAPHED IN FRONT OF LOUGHBOROUGH'S FAMOUS CARILLON TOWER.

him from being with them; he referred to Mr. Oliver Stubbs. Though their old friend was very ill, he was delighted to report that on Sunday last there had been a decided change for the better. Mr. Stubbs and his family would have their deepest sympathy during that extremely trying time, and he would send on their behalf a message condoling with him on his illness and congratulating him on the slight recovery that he had had. (Applause.)

Annual Report of the General Council for the Session, 1927-1928.—It was agreed that the Report of the Council be taken as read.

Annual Report of the General Council for the Session, 1927-28.

The General Council has pleasure in presenting to the Members the Report of the work for the year 1927-28.

The membership lists have been revised and the names of all members whose membership has lapsed have been removed. The total number of erasures, due to deaths, resignations, and lapsed membership, is 156, but 249 new members have joined the Institute during the year. There is, therefore, a net increase of 93. The total number of members on the roll on April 30 was 1,729; 13 associate members have been transferred to the grade of member, and six associates have been transferred to associate membership.

The Council regret to announce the deaths of ten members and associate members.

Although a large number of names have been removed from the Roll during the year, a record number of new members has been admitted, and the net increase of membership is one of the largest to be recorded for many years. At the General Council Meeting, held on January 21, 98 applications for Membership and transfers to higher grades were passed. This is one of the largest numbers of new members ever admitted at one Council meeting. As a result of increased membership in the Bristol area, three meetings have been held during the Session for the benefit of members in Bristol and district.

Junior Sections.

There are new Junior Sections in connection with five Branches, namely:—Newcastle, Lancashire, London, Birmingham, and Scottish. The Scottish Junior Section is the latest addition to this number, and was formed in October last at a very largely attended meeting held at the works of Messrs. G. & J. Weir. The Section has held a very successful initial session, and there is every promise of excellent work being carried out in the future.

Oliver Stubbs Gold Medal.

The Sixth Medal was awarded in July last to Professor Thomas Turner, Emeritus Professor of Metallurgy at Birmingham University, for long and devoted services to the Institute.

Diplomas.

Seven Diplomas were awarded in July last for Papers given before the Branches during the previous Session. The recipients and the respective Branches before which the Papers were given are as follows:—Messrs. H. C. Dews (London), J. W. Donaldson (Lancashire), H. V. Grundy and A. Phillips (Lancashire), J. E. Hurst (Sheffield), W. J. Molineux (Newcastle), A. E. Peace (East Midlands), and H. Field (Birmingham).

Annual Conference, 1927.

The Twenty-fourth Annual Convention was held at the University, St. George's Square, Sheffield, in July. Mr. J. T. Goodwin, M.B.E., was installed President at the Convention, which was attended by an exceptionally large number of members and ladies. The President and Council wish to place on record their indebtedness to the Lord Mayor and Lady Mayoress of Sheffield, the Master Cutler and Mistress Cutler and the University authorities for their hospitality and cordial co-operation which helped to make the conference technically and socially successful. The success of the conference was also due to a large extent to the courtesy of the famous firms in Sheffield and District who invited the members to visit their works and to the subscribers to the conference funds.

The next Annual Conference will be held on June 12, 13, 14 and 15 at the Association Hall, Leicester.

General Council.

Four General Council Meetings and a large large number of Sub-Committee Meetings have

been held during the year at Sheffield, York, Derby and Manchester, respectively. All Branches have been well represented, and there has been an average attendance of 37 at the General Council Meetings. The following Members of the General Council retire at the General Meeting on June 13:—Messrs. A. R. Bartlett, J. R. Hyde, H. Pemberton, G. E. Roberts and J. Shaw. Messrs. Bartlett, Hyde, Pemberton and Shaw offer themselves for re-election.

Test Bar Committee.

Members will be pleased to learn that the revised specification for grey iron castings has now been issued by the British Engineering Standards Association after agreement with the chief Government Departments, railway companies and leading technical societies.

The Test Bar Committee is now investigating the possibilities of the shear test, and hopes to have sufficient information to put before the members so that they can form their own opinion before the matter is again brought forward at the International Convention to be held in London in 1929.

British Cast Iron Research Association.

Although as a consequence of the general industrial situation following the coal strike the increase of members is slow, the British Cast Iron Research Association continues to make steady progress, and its latest development is the completion of arrangements for the Association to have its own melting plant for crucible and cupola melting, facilities for which have been kindly placed at the Association's disposal by one of their members.

A feature of the work during the year past has been the development of large scale practical work in members' foundries, and in particular an important series of cupola tests have been carried out in no less than three weeks. Over fifty research reports have now been issued by the Association, and their number is steadily increasing.

International Relations.

The relations of the Institute to foreign foundry Associations have been strengthened during the year. In September of last year a party of members and ladies visited the International Foundry Conference and Exhibition in Paris. Members of the Institute were also present at the European Foundry Congress held in Barcelona in April of this year.

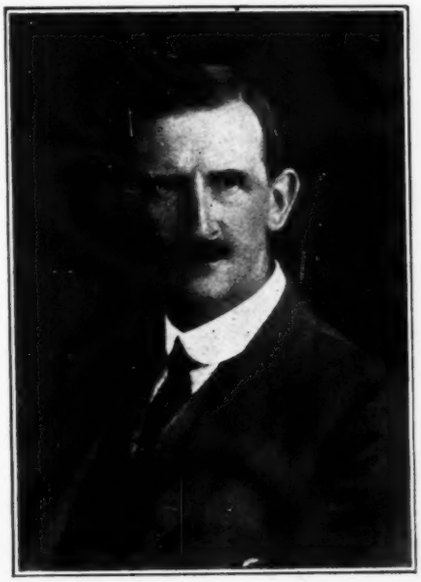
Exchange Papers have been presented on behalf of the Institute to the following Conferences of Overseas Foundry Associations—Dr. A. B. Everest, Spanish Foundry Conference, April, 1928, and Mr. F. A. Melmoth, Conference of American Foundrymen's Association, May, 1928.

Messrs. H. C. Dews and J. W. Donaldson are preparing Papers on behalf of the Institute for presentation to the Belgian and French Foundry Conferences respectively.

to the Literary and Awards Committee of the General Council for preliminary consideration. This Committee will in future be known as the Literary, Awards and Education Committee.

Accounts.

The statement of accounts and balance-sheet for the year ended December 31, 1927, are set out below. During the year every effort has been made to effect economical working, consistent with efficiency. The income for the year exceeded the expenditure by £120, a result which compares very favourably with the loss of £156 6s. 2d. on the previous year. It is hoped that with an increase of membership and continued economy, sufficient funds will be accumulated to extend the work and usefulness of the Institute.



MR. F. P. WILSON, J.P.,
Junior Vice-President.

Mr. Wilson is foundry manager to Messrs. Pease & Partners, Limited. He was educated at Middlesbrough High School and Giggleswick Grammar School. He served his engineering apprenticeship at the Tees-side Engine Works of R. Stephenson & Company. He is joint patentee in the expanded metal reinforcement for brake blocks. Mr. Wilson is a member of the Middlesbrough Education Committee, the Councils of the Constantine Technical College, the Cleveland Scientific and Technical Institute, whilst he has presided over the Cleveland Institution of Engineers and the Y.M.C.A. He is a life governor of North Riding Infirmary, an assistant commissioner of the St. John Ambulance Brigade, assistant county controller of the North Riding V.A.D., and a Serving Brother of the Order of the Hospital of St. John of Jerusalem. He was a founder and first president of the Middlesbrough Branch of the Institute.

MEMBERSHIP, APRIL 30, 1928.

	Subscribing Firms.	Members.	Associate Members.	Associates.	Total.
Birmingham, Coventry, and West Midlands	2 (2)	81 (68)	91 (106)	17 (16)	191 (192)
East Midlands	1 (0)	37 (34)	68 (57)	4 (4)	110 (95)
Lancashire	8 (9)	114 (108)	198 (193)	11 (8)	331 (318)
London	3 (2)	130 (112)	81 (82)	12 (8)	226 (204)
Middlesbrough	4 (4)	31 (26)	27 (27)	5 (8)	67 (65)
Newcastle	10 (10)	56 (67)	52 (60)	77 (72)	195 (209)
Scottish	1 (0)	68 (54)	143 (115)	30 (30)	242 (199)
Sheffield	7 (6)	84 (81)	84 (96)	11 (13)	186 (196)
W. R. of Yorkshire	—	29 (25)	56 (53)	2 (2)	87 (80)
Wales and Monmouth	—	25 (17)	22 (12)	4 (4)	51 (33)
General	—	34 (32)	8 (12)	1 (1)	43 (43)
Total	36 (33)	689 (624)	830 (813)	174 (166)	1,729 (1,636)

The figures in brackets are for the Session 1926-1927.

Arrangements are already in hand for the International Congress which will be held in London in June, 1929. An International Foundry Exhibition will be held in London at the same time.

Apprentice Training.

The question of training foundry apprentices has been revived and the matter has been referred

Increase of Membership.

It has been appreciated by all members that the time has arrived when special efforts should be made to increase the usefulness of the Institute by a substantial increase in the number of members. Considerable efforts in this direction have been made during the past year by the Branches and by many individual members, and the net increase of 93 shown in the earlier part of this report is the result.

The Council confidently appeals to every member to bring before the notice of non-members the advantages of Membership of the Institute.

The Council desires to express its thanks to all the firms who have arranged for visits to their works and to all those gentlemen who have contributed papers to the Branches and to the annual conference.

J. T. GOODWIN, President.
TOM MAKEMSON, General Secretary.

Balance Sheet.

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED DECEMBER 31, 1927.

EXPENDITURE.

	£ s. d.	£ s. d.
Postages		100 0 1
Printing and Stationery, including Printing of Proceedings		542 10 1
Preparation of and Printing and Binding of Indexes		76 2 0
Council, Finance and Annual Meeting Expenses		58 14 4
Medals for Past Presidents		2 6 6
Branch Expenses:—		
Lancashire	98 9 6	
Birmingham	61 8 0	
Scottish	80 7 10	
Sheffield	45 18 9	
London	47 14 1	
East Midlands	24 12 0	
Newcastle	102 16 2	
West Riding of Yorkshire	23 10 2	
Wales and Monmouth	13 8 0	
Middlesbrough	20 1 0	
		518 5 6
Audit Fee and Accountancy Charges (2 years)		23 2 0
Incidental Expenses		65 5 7
Salaries—Secretary and Clerk		437 7 7
Rent and Rates of Office, less Received		110 3 6
Income Tax		6 10 0
Subscription to International Committee of Foundry Technical Associations		5 0 0
Depreciation of Furniture		6 18 4
		1,952 5 6
Excess Income over Expenditure		120 17 5
		£2,073 2 11

INCOME.

	£ s. d.
Subscriptions Received	1,976 7 1
Sale of Proceedings, etc.	21 0 6
Interest on War Loan and Cash on Deposit	38 14 6
John Surtees Medal Fund Surplus	37 0 10
	£2,073 2 11

BALANCE SHEET, DECEMBER 31, 1927.

LIABILITIES.

	£ s. d.	£ s. d.	£ s. d.
Subscriptions paid in advance			103 8 6
Sundry Creditors			411 5 2
The Oliver Stubbs Medal Fund:			
Balance from last Account	204 16 4		
Interest to date	8 4 4		
	213 0 8		
Less Cost of Medal	9 10 0		
		203 10 8	
Turner Testimonial Fund:			
Sundry Receipts		72 14 4	
Surplus at December 31, 1926	829 19 4		
Add: Excess of Income over Expenditure for year ended December 31, 1927	120 17 5		
		950 16 9	
			£1,741 15 5

ASSETS.

	£ s. d.	£ s. d.
Cash in hands of Secretaries:		
Lancashire	22 14 2	
Birmingham	14 4 2	
Sheffield	121 6 1	
London	98 1 8	
East Midlands	19 0 9	
West Riding of Yorkshire	27 1 4	
Wales and Monmouth	1 16 9	
Middlesbrough	18 7 5	
		322 12 4

Assets (*continued*.	£ s. d.	£ s. d.
Lloyds Bank Ltd.:		
General Account	204 10 0	
Deposit Account	400 0 0	
		604 10 0
The Oliver Stubbs Medal Fund:		
£342 5s. 7d. Local Loan £3 per cent. Stock at cost	200 0 0	
Balance in hand, Lloyds Bank, Ltd.	3 10 8	
		203 10 8
Turner Testimonial Fund:		
Cash at Bank	71 14 6	
Cash in Hand	0 19 10	
		72 14 4
Investments Account:		
£100 5 per cent. National War Bonds		432 10 1
£350 5 per cent. War Loan at cost		
Furniture, Fittings and Fixtures:		
Per Last Account	69 2 10	
Less: Depreciation, 10 per cent.	6 18 4	
	62 4 6	
Additions	43 13 6	
		105 18 0
		£1,741 15 5

We have prepared and audited the above Balance Sheet with the Books and Vouchers of the Institute, and certify same to be in accordance therewith.

J. & A. W. Sully & Co.,
Chartered Accountants,
Auditors.

19/21, Queen Victoria Street,
London, E.C.4. May 7, 1928.

Mr. Goodwin, in referring to the balance-sheet, commented on the considerable saving that had taken place during the past year, with the result that, as against a debit balance of £156 in the previous year, the Institute had a credit balance of £121. (Applause.) That was due to increased membership. They had had a record number of new members.

Mr. Hider (Torquay), in proposing the acceptance of the balance-sheet, made the suggestion that their finances might be considerably augmented if their membership were further increased by vigorous propaganda work throughout the country. He motion, desired to support the compliment that had been paid not only to the Branch Secretaries but to their General Secretary, who must have had a very hard year. They must all acknowledge that he had been remarkably successful in the results.

The resolution was carried unanimously.

Election of Officers for 1928-29.

President.

Mr. Goodwin said that the Council yesterday had unanimously passed a resolution that the Senior Vice-President (Mr. S. H. Russell) should

A Group of Visitors to the Leicester Convention at Mr. S. Gimson's Cottage in the Charnwood Forest.

and his son were delighted to travel the long distance from the South to attend the Conference so as to be able to interchange ideas with others; but, unfortunately owing to being such a terrible distance from any other member, that was the only benefit they, as individual members, obtained from the Conference. Their nearest neighbour was 87 miles from them at Yeovil. He pleaded that some propaganda might be done in the West of England. The West of England was not merely a beautiful place but it was also the centre of a string of little foundries and general utility businesses. Exeter had seven; Plymouth had eight, and there were a number of others right down almost to Land's End. He urged on them that the project of increasing the Institute's membership in the West, with the idea of ultimately forming a Western District Branch, should engage the attention of the Council and their excellent Secretary. (Applause.)

Mr. Harley (Coventry), in seconding the be their President for the ensuing year. As the retiring President, he had the honour of proposing that that recommendation of the Council be accepted. In Mr. Russell they would have one who would more than further the interests of their Institute. He was a keen, hard-working and enthusiastic member of the Institute. (Applause.) He had the advantage of being associated with one of the most important iron foundries in Leicester. (Applause.) Mr. Russell knew very well the responsibility he had to take hold of in his new office. He had helped him (the speaker) considerably during his term of office on all kinds of difficult points, which did not always come before either the Council or the members as a whole.

Mr. F. J. Cook, the senior of the Past-Presidents, in seconding, said that he had known Mr. Russell through the agency of their Association for a great many years, and had always looked upon him as one who, in due course, would worthily fulfil the office for which he was being

proposed. He could endorse all that the President had said with regard to the abilities of Mr. Russell to fulfil the duties which were expected of him, and he was sure that, at the end of his term, he would have covered himself with glory and have occupied the post to their entire satisfaction.

The resolution was passed with great enthusiasm. Mr. Goodwin then invested Mr. Russell with the President's Chain of Office, and the latter formally occupied the chair amid loud cheers.

The PRESIDENT (Mr. S. H. Russell), in expressing appreciation at his election, assured them that he felt a very great and very high honour had been conferred on him. He realised that he was following in the steps of some of the most famous men in their industry, men who by patience, perseverance, and often under great difficulties, had done much research work, and had given the benefit of that work to the industry generally, with profit to the members. He could claim no such distinction. All he could say was that he had benefited very much indeed by his membership of the Institute, by his fellowship and association with all the members at different meetings, and particularly in meetings at his own branch, so that, in his occupancy of that post, it was only due to them to attempt to make some small return for the many benefits that he had received from his connection with the Institute. He was very deeply interested in its work, and he would promise them that he would do his best. He hoped that, when the end of his term came, he would have as good a record as their immediately retiring President, Mr. Goodwin.

Vote of thanks to ex-President.

The PRESIDENT said that his first duty was to express their very hearty and sincere thanks to Mr. Goodwin for the extremely able way in which he had conducted the affairs of the Institute during last year. Mr. Goodwin was certainly the man to tackle what was always a difficult problem, the problem of finance, and they could congratulate him heartily upon the splendid recovery which had been made. At Sheffield some of them were a little despondent. There was an adverse balance, and trade was bad. Mr. Goodwin had wholeheartedly tackled the problem of finance, and, with the assistance of Mr. Makemson, the Institute had made a splendid financial recovery as a result. In practically every feature of the work of the Institute, Mr. Goodwin had shown an unbounded enthusiasm. He had not spared himself in the least. In fact, Mrs. Goodwin, he rather understood, felt a slight resentment at the amount of work Mr. Goodwin had put in on behalf of the Association, and he was sure they all ought to express to Mrs. Goodwin their very sincere thanks for what he had done. (Applause.)

MR. COOK, in seconding, said that the work of the President became more onerous every year as the Institute grew, especially with regard to finance. The expenses were very great, and they were handling quite an appreciable amount of money. It required an amount of exceptional executive ability, as well as being a good foundryman, to govern and rule over them in the capacity of President. The least they could do was to thank him most heartily for having undertaken the work on their behalf. He had great pleasure in seconding the vote of thanks.

The motion was carried with acclamation.

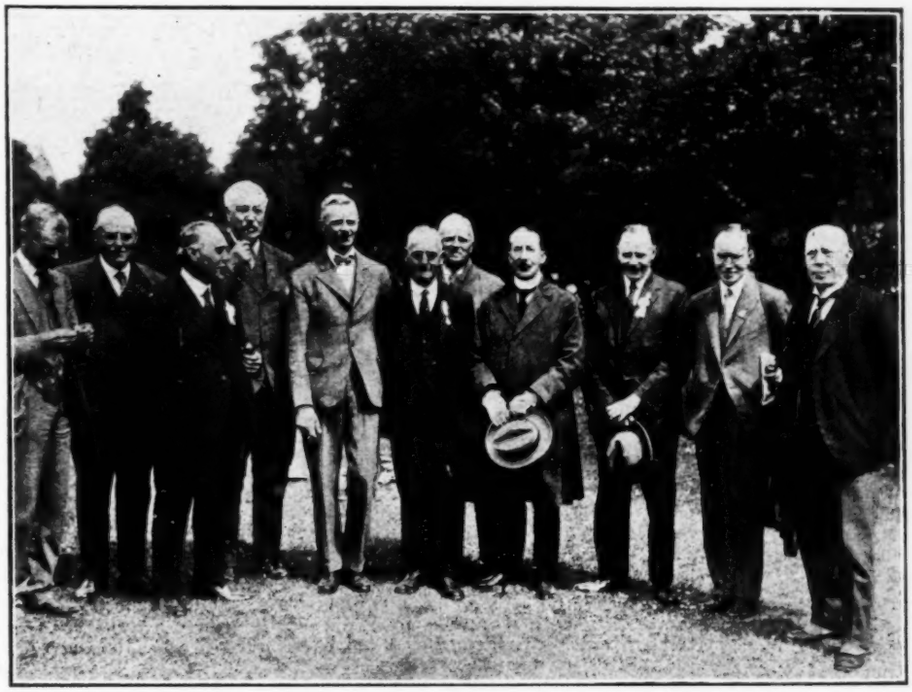
Presentation of Medal to Past President.

The PRESIDENT said there was one pleasant function which remained after thanking the Past President for his services, which was to hand to Mr. Goodwin, as a little souvenir of his year of office, the replica of the badge. He hoped that, although Mr. Goodwin might have found the work arduous, that memento would remind him of the many happy times he had had, and would act as some slight reward and return for the services he had rendered. (Prolonged applause.)

MR. GOODWIN, in responding, thanked them all for the kindly words which had been said, which more than amply rewarded him for the work he had done for the Institute. The generous way in which the members had all shown their appreciation by their applause had heartened him very much. He felt leaving the Presidential chair very much indeed; but the expression of esteem which they had given him certainly recompensed him for having to relinquish an office which he had thoroughly enjoyed filling. He thought during the debates, in Council and elsewhere, they appreciated that every move that he had made had been in the interests of the Institute, and not from any personal feeling of his own. (Applause.)

Vice-Presidents.

The PRESIDENT said the office of President next year was going to be a highly important one, because there was an Overseas delegation, which would number about 300, visiting them. He had the greatest possible pleasure in nominating Mr. Wesley Lambert as their senior Vice-President. He was particularly delighted to do that, because it was greatly to the interests of the Institute to have a non-ferrous man so well known as Mr. Lambert was in connection with non-ferrous work in the chair. They tended a little to concentrate on the cast-iron side, in which side no doubt the majority of their members were interested; but there was much important work to be done on the non-ferrous side; and from that point of view, therefore he was pleased that they had Mr. Wesley Lambert to step into that office.



A LEAF FROM THE INSTITUTE'S FAMILY PORTRAIT ALBUM.

Left to right: Mr. John Cameron, Mr. F. J. Cook, Mr. H. Pemberton, Mr. S. Gimson, Mr. S. H. Russell Mr J. Ellis, Mr. S. Russell, Mr. W. Lambert Mr. H. Bunting, Mr. T. Makemson and Mr. Purnell.

MR. FAULKNER (Past-President) seconded with the greatest pleasure the proposal to elect his colleague in the London branch as senior Vice-President of the Institute. Mr. Lambert had achieved an international reputation as a non-ferrous metallurgist. He had not merely sat upon most of their committees, but had directed them during the last two or three years. Furthermore, in co-operation with his colleagues in the London branch, he had raised that particular section of the Institute from a condition bordering upon being derelict to the position which it occupied as the premier branch of the Institute. (Loud applause.) In general membership it was not quite as large as others, but in the amount of money it sent to the Central Office it certainly was first, though to say that might sound a little ungracious to the branch whose hospitality they were enjoying. Mr. Lambert had also attended several international gatherings, and had presented a Paper on their behalf to the American Association. They were not merely honouring Mr. Lambert in asking him to be their senior Vice-President, but they were also honouring themselves. It was a reciprocal arrangement, and one which it gave him very great pleasure to second.

MR. GOODWIN also supported the nomination.

The motion was carried with enthusiasm.

MR. WESLEY LAMBERT, in returning thanks, said he was very pleased to accept the office, which he did fully conscious of the fact that, if everything went right, and when in due course he took the position of the chair, he had to look forward to a very, very onerous presidential year of office. That year of office would include the International Conference. They would imagine his feelings when he had heard that it was not at all unlikely that no less than 200 Americans would be coming to attend that Conference, to say nothing of a large contingent from the Continent. At the same time, knowing the London branch, and particularly the secretary of the London branch, and knowing the Council, he had no hesitation whatever in taking office, because he felt sure the London branch would not let him down when it came to the International Conference. (Applause.) They were working very hard indeed to make that Conference a huge success, so that it would redound to the honour and glory of the Institute of British Foundrymen. That could not be done unless they had the whole-hearted support of every member of the Institute. He felt sure that the acclamation with which they had received his nomination was an expression of their willingness to give him and the London branch the assistance which they would certainly need when the International Conference came along. (Applause.)

MR. H. WINTERTON (Glasgow) then moved the nomination of Mr. F. P. Wilson, of Middlesbrough, as junior Vice-President. It was in 1907 that he had visited Middlesbrough for the Conference, and he had a distinct recollection of the excellent time they had there. Mr. Wilson was the past president of the Middlesbrough section. The time had come when they should pay another visit to Middlesbrough, and he was sure both Mr. Wilson and his colleagues would do their best to provide them with a good conference in due time at Middlesbrough.

MR. J. CAMERON (a Past-President) seconded the motion. They would remember it was a very interesting duty of the President when the opportunity came to visit a body of ironfounders who wished to form a new branch. That was the great privilege he had had in his year of office. He

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was heartily supported in that by Mr. Patterson, his immediate predecessor, of the Newcastle branch. They both went to Middlesbrough, and Mr. Wilson took a prominent part in creating the Middlesbrough branch. He and Mr. Ridsdale, the capable secretary, did everything in their power to make the meeting a success; and the result of the open meeting on the Saturday evening was that something like 80 names were handed in. It was a great pleasure to him to find that new branch doing so well as to be able in such a short time to put up a president of their own.

The motion was put and carried with acclamation.

Mr. F. P. Wilson, in responding, remarked that he was probably quite unknown to the bulk of the members, and, in electing him to that office, they had backed a dark horse. (Laughter.) He was very greatly surprised when, at the Council meeting last night, the suggestion had been made. It was the very last thing that he had in mind in coming to Leicester, and had he suspected it might happen he probably would not have been there at all. He felt, however, when pressure was put upon him, that it was not a personal matter, but was a matter of the good which one sought for one's own branch in particular, and, of course, for the good of the Institute as a whole. The Middlesbrough branch was very young, but they felt that a district like Middlesbrough should support a strong branch of the Institute. If, by a visit of this Convention to Middlesbrough, something could be done to elevate the foundry trade as a whole in that town and raise them from the position which most people in the Midlands and the South considered they occupied—he was afraid they were rather looked upon as savages—it would be a great advantage. No doubt it would help to enlighten and civilise them a little to have a visit from such a body as the Institute. He felt quite unfitted for the position; but, if it was their wish that he should occupy it, he felt, as a matter of duty, that he could not refuse to do so. (Applause.)

Presentation of "Oliver Stubbs" Gold Medal.

The President said that the next item on the agenda was the award of the "Oliver Stubbs" medal. After considering the matter very carefully, the Literary and Awards Committee had recommended to the General Council that the "Oliver Stubbs" medal should be awarded to Mr. J. W. Donaldson, B.Sc., A.I.C., of Greenock, who had contributed many Papers to the "Proceedings" of the Institute, embodying his researches upon cast iron. As Mr. Donaldson was unfortunately unable to be present the medal was formally handed to Mr. Winterton, who promised to convey it, with the felicitations of the Convention, to Mr. Donaldson.

Diplomas.

The Secretary stated that diplomas had been awarded to the following gentlemen in connection with Papers laid before their Branches during the past session:—Mr. A. J. Beck, for his Paper on "Some Methods of Production in the Modern Malleable Iron Foundry"; Mr. F. Hudson, for his Paper on "Scottish Moulding Sands,"; Mr. P. A. Russell, B.Sc., for his Paper on "Shrinkage Holes in Small Grey Iron Castings"; Mr. N. D. Ridsdale, for his Paper on "Practical Moulding Sand Control"; Mr. W. H. Poole, for his Paper on "Cupola Practice."

Trustees.

On the proposition of the President, seconded by Mr. Faulkner, the following were re-elected Trustees of the Institute:—Mr. F. J. Cook, Mr. Oliver Stubbs and Mr. R. O. Patterson.

Re-election of Auditors.

On the motion of the President, seconded by Mr. Cook, Messrs. J. & A. W. Sully & Company (chartered accountants) were re-elected auditors.

Hon. Treasurer.

On the motion of Mr. Cook, seconded by Mr. Stevenson, Mr. F. W. Finch was re-elected Hon. Treasurer, Mr. Cook remarking that, as he had served his apprenticeship under Mr. Finch, he could claim to know something about him, as he had known him for a very long time.

On the motion being carried, the President remarked that they would be interested to know that they had just received a message of good wishes from their old friend, Mr. Finch, whose health did not permit him to attend the meetings.

Members of Council.

As the result of the ballot to fill the five vacancies on the General Council, the following were re-elected:—Mr. Bartlett (London), Mr. A. R. Campion (Scotland), Mr. J. R. Hyde (Sheffield), Mr. H. Pemberton (East Midlands) and Mr. John Shaw (London).

Buchanan Medal Donation.

Mr. Goodwin said that he had been asked by the President to state to the Conference the terms of the donation in connection with what was known as the Buchanan medal. It was an exceedingly great pleasure to him that, during his year of office, the memory of their first President should be honoured by an anonymous donor, who wished Mr. Buchanan's memory to be perpetuated. Mr. Buchanan was one of the pioneers of foundry research. Mr. Buchanan had had considerable difficulty, with others, in bringing these matters to

In a Happy Mood—Mr. and Mrs. S. H. Russell.

a technical head; but they were very grateful for the work he had done. It was acknowledged to be the foundation of the work they were carrying on. Even in his later years, Mr. Buchanan was ever wishful to help those who were in difficulties with foundry matters. The conditions of the awarding of the medals briefly were these: That the medals should be given to the Junior Branches only, one medal for each Branch. Any member of a Junior Branch who wished to compete for the medal must write an essay, giving a *résumé* of the work done in the particular Branch of which he was a member during the session. At a certain time an examination would take place, which would be conducted by the Literary and Awards Committee with the supervision of the Council. The conditions were practically the same as the conditions of the "Oliver Stubbs" medal. He would read a letter from the Midland Bank which summed up the whole position: "Dear Sir,—We have the pleasure to inform you that we have received instructions to purchase £125 worth of 3½ Per Cent. Conversion Loan on behalf of your Institute, the dividends to provide annually the Buchanan medals in silver under the scheme with which you have already been acquainted. We shall be glad to have the names of the Trustees, together with specimen signatures. Our client suggests that those Trustees should be the President, the President-Designate, and the Secretary of the Institute of British Foundrymen, any two of whom shall have authority for effective signature. Kindly complete and return to us the enclosed form.—Signed, F. Burrows, the Accountant for the Bank." The die from which those medals would be made in future—also a gift—would also become the property of the Institution. That was a great asset, as it left the money quite free to be spent on these medals. He was very delighted that the donor had thought fit during his year of office to negotiate with him, through the Literary and Awards Committee, for the carrying into effect of this splendid donation on his part. (Applause.)

The President, in accepting that handsome gift, moved that they accept the donation to form a fund for the Buchanan medals, and that they also expressed to the anonymous donor their very hearty thanks for the fund which he had generously handed over to them to provide these medals for competition year by year among the junior members. (Loud applause.)

Mr. B. Hird (South Wales), in seconding, said that Mr. Buchanan, a good many years ago, was a very kind friend to him, and helped him considerably. He would like to thank the donor for doing something which he had felt, had he been in the position to do so, it would have been an appropriate thing for him to have done, because Mr. Buchanan had helped along many struggling members in the years that had gone by.

The motion was carried with enthusiasm.

The President said he presumed they would accept as the three Trustees the President, the President-Designate, and the Secretary of the I.B.F. (Agreed.) He took it that the Trustees would change as the officers changed, so that there would be no risk of difficulties arising through the passing away of any of the Trustees.

Presidential Address.

Mr. S. H. Russell then delivered his Presidential Address.

Mr. Goodwin and Gentlemen,

I feel that the members have every reason to be satisfied with the progress of the Institute during the past year. When we met at Sheffield we had just completed the first year with our secretary and offices at Manchester, and many of us were afraid that a retrograde step had been taken. I believe that at Sheffield we all realised that the move was a wise one, but that there were still many difficulties ahead of us, mainly owing to the increased expenditure incurred. The thanks of the Institute are due to Mr. Goodwin for the courageous way in which he tackled this problem, and the very satisfactory improvement which has been made in our finance is due mainly to the increase in our membership, to which both Mr. Goodwin and Mr. Makemson have devoted much of their time and energy. We need still larger funds at headquarters to carry out adequately all the work the Institute should do, but I have every confidence that we shall still further increase our membership, and that we may hope for an increase in the number of subscribing firms and in the transfer of associate members to full membership. In my opinion no foundryman can afford to stay outside the organisation.

The members of this Institute are under a deep debt of gratitude to the members of the Council for the splendid attendances they make at the Council meetings. Our Branches are scattered all over England and Southern Scotland, many members have to travel long distances, usually at their own expense, and have to give up their Saturday, and yet we get attendances of 35 to 40 at our meetings, thus proving their interest in the Institute.

In October last care was taken to appoint subcommittees which were really representative, and I believe these committees have functioned more to the satisfaction of the Council than has been the case on some occasions.

As regards the individual member, the value of the Institute depends considerably upon the Branch to which he is attached, and as to whether he attends their meetings or not.

A newly-elected President has very little opportunity of knowing the workings of any Branch other than his own, and during his year of office he usually visits other Branches at their annual dinner, at which the atmosphere is certainly

different from that of an ordinary meeting, often held in a lecture room in which the seats are not designed for comfort.

Branch Programmes.

Upon the Councils of the various Branches rests a heavy responsibility as to the papers presented to their members, and I wish to urge upon all Branch Presidents, Secretaries and members of Council the necessity of obtaining good programmes, and of taking every possible step to encourage what is generally known as the discussion, and also to develop a feeling of comradeship amongst the members. In connection with this works visits are an important item. It is not always that the actual visit to the works is of great value to certain members who are in another section of the industry, but the opportunity of meeting and discussing with other men, some of them experts, in this informal way, is of very great value. It is encouraging to find a reference to one or more works visits per session in the Branch programmes, and I hope that those Branches who have made no reference to same have arranged such functions, and that they have been well supported by their members.

With further reference to the question of papers presented to the Branch meetings, I would suggest that a mistake is sometimes made in endeavouring to obtain a large proportion of original papers. There are 13 Branches (excluding Junior Branches) at which on the average 6 papers are presented per annum. This means, if every one is original, and presented at one Branch only, 78 papers per annum (in addition to those presented at the annual conference) are given.

I am aware that the number of problems in foundries is almost infinite, but with all due respect to our members, I do not think we can expect anything like 78 original papers every year.

Again, many of the papers read before the Branches are the fruit of much study and experience, usually illustrated by lantern slides, diagrams or samples, and yet even when awarded a diploma many of these papers are presented only once, and their value to the industry is mainly lost. It will greatly encourage the author of a really good and original paper if he is invited to present it to another Branch, and it will probably mean that as the result of previous criticisms the paper will be improved, and of even more value when read a second time. Will Branch Councils when drafting this next programme consider my argument and see whether they cannot include some of the papers which have been awarded diplomas this year?

One other thing, whilst on the topic of Branches. It is disquieting to read in the report of the annual meeting of one of our largest and oldest Branches that there were no retiring members of Branch Council, occasional vacancies having been filled up in previous years for the full period of three years. In justice, I must add that the matter of a number retiring each year is to be reconsidered, but I believe that the life and soul of a Branch is its Council, and that it is essential that every year members should have an opportunity of introducing fresh stock if in their wisdom they deem it advisable. I have obtained much pleasure, and, may I say, a little wisdom, from being actively associated with my own Branch, and I am anxious that all other members shall have every opportunity of enjoying the privileges and advantages I have had.

An Entrance Examination.

The Literary and Education Committee have before them two very interesting and important matters, which they have to consider during the next year. The first of these is the suggestion several times made, but becoming more insistent, that some form of examination should be passed before new members are admitted to the Association. This really is a move to raise the status of membership in our Institute, and is very desirable. Our title clearly indicates the qualification necessary, that of a foundryman. But it is a difficult thing to put into writing exactly what qualifications are necessary before one can claim that name. You will find men mixing and alloying white metals, and who never use a sand mould from one week-end to another, others working loam, and with the aid of a few strickles and a blue-print producing very successfully large castings in iron or bronze, others who specialise in mass-production methods, and who produce enormous quantities of a few articles, often, again, without using a sand mould, though they may use sand cores, and, lastly, all those who supply the necessary raw materials for the industry, many of them not foundrymen in one sense of the word, and yet having a specialised knowledge of one or other section of the industry. If you attempt to frame a set of questions which you may expect a jobbing foundryman to answer, can you hope that men engaged in these more specialised branches can answer them satisfactorily. In some societies it is necessary for a candidate to write a thesis on some branch of the industry, but many of our worthiest members are craftsmen, who have no literary gift, and it seems to me that when the time is ripe for this development considerable thought and care will be necessary in deciding what tests are to be applied to candidates for election.

A National Certificate.

The other and probably more pressing matter is the question of a national examination in foundry practice, and I am sure that it is very gratifying to all our members that the enterprising Editor of our official organ, THE FOUNDRY TRADE JOURNAL, has appointed a special commissioner, who will visit every important educational centre, and will report upon the facilities which at present exist for the scientific and technical training of future foundrymen. In reading through the first article on this subject (published on May 10 last) I gather that a slight confusion exists. The Institute proposes at the moment to request the City and Guilds of London Institute or other authoritative educational body to carry out the examination of candidates attending the various foundry classes up and down the country, so that instead of the local certificate issued to successful candidates, a national certificate will be issued which will naturally carry much more weight. It appears to me that students attending a University or University college will require a higher form of certificate than this, and probably the Institute will have to adopt a scheme such as is already carried out by kindred societies, to cater for what I may term the more advanced type of student.

In other words, the Institute proposes, with the assistance of the City and Guilds of London Institute, to arrange for a national certificate to be competed for by persons training at evening schools or on a part-time scheme, and has yet to tackle the other problem of a suitable award or diploma which will carry national recognition, and entitle the owner to be recognised as a fully-qualified foundryman, capable of stepping immediately into an executive position.

To assist in the promotion of either of these schemes it will be helpful to our Institute to have first-hand and up-to-date information on existing educational facilities both at our University Colleges and at our Schools of Technology, and we welcome the assistance of THE FOUNDRY TRADE JOURNAL in this direction.

Very much akin to this subject is the question of the training of foundry apprentices, and I consider that our worthy secretary, Mr. Makemson, has made a very valuable contribution to this problem in the Paper he has presented to one or two of our Branches during the last session. In connection with this matter one difficulty I have not seen commented upon is that many of the modern and progressive executives engaged in foundry work are concentrating upon mass production, methods which tend to eliminate the skilled moulder, and, in fact, all craftsmanship. These firms can probably obtain the type of labour they require with less difficulty than the foundryman who has to rely upon the skill of the moulder to produce satisfactory castings. It is easier and more remunerative to-day to produce a limited variety of castings in large numbers, than it is to produce a larger variety of castings in limited numbers, and, speaking broadly, I believe I am right in saying that the works producing this second type of casting are smaller and less well-organised than the other section of the industry, so that some of the men to whom we look for leadership and help do not feel the necessity for the long-overdue improvement in the quality of foundry apprentices, whilst others to whom the need is so much more pressing seem incapable of taking the bold and resolute steps necessary to effect an improvement.

The Work of the B.C.I.R.A.

One of the objects of our Institute is to initiate, conduct, and supervise researches, all as set out in paragraph d, section 1, of the by-laws. As you all know, the practical outcome of this was the formation of the Cast Iron Research Association, which has now been functioning for over six years. Real and accurate research work is necessarily slow, and some of us tend to be impatient because the Association has not yet set the Thames on fire. Mr. Pearce, its director, informs me that during the past year the most notable feature of the work of the Association has been the extension of work of a practical character. In connection with cupola melting economy, the Association has produced a new design which offers exceptional means for control, and which in working is giving quite unusual melting economies. In addition to this, a series of tests are being made in conjunction with Mr. R. O. Patterson on various cupola cokes, by means of which differences between different types of coke, different grade sizes, and different methods of manufacture are being shown to have a definite influence on melting rate and economy. A similar series of tests on different cupola linings is in active preparation. Certain proprietary cupola designs have been examined, and tests supervised for the benefit of members. Practical melts have also been made on light casting irons with a view to determining the influence of constitution of strength.

Work on moulding sands and on malleable cast iron has been proceeding actively, and notable progress has been made in connection with the influence of nickel on cast iron. One of the most interesting developments during the year has been that of a special alloy cast iron, which is, under certain corrosive agents, virtually corrosion-proof.

If I may venture a criticism it is this. The report issued by the Government Department Commissioners was very favourable, but had one unfortunate and rather unlooked for effect, and that was the insistence upon the appointment of a further fully qualified scientific member of the staff, at a time when the funds of the Association did not permit them to also employ additional help upon the practical side. There are two or three men in this country, at present employed as experts or in an advisory capacity by commercial firms, any one of whom could help the industry far better if they were members of the staff of the Research Association, and it is unfortunate that this recommendation was insisted upon by the Department concerned at such a time.

Foreign Relationship.

It is very pleasing to note the close contact maintained with foreign societies, not only through the Exchange Papers, but also through visits to their conferences, and the successful functioning of the International Committee is very gratifying. The thanks of the Institute are due to Mr. Faulkner and to Mr. Makemson for the invaluable work they do in this connection. We are looking forward to receiving a visit next year from overseas foundrymen, and a preliminary programme embracing a three weeks' tour of Great Britain is already in the hands of our foreign friends. We are all looking to the Branches doing their share towards entertaining these guests, and letting them see that the foundries in Great Britain are more progressive and capable than some of our pessimists would have us believe. This tour culminates in London, where we are holding our next Convention, and where simultaneously will be staged an International Foundry Exhibition.

Members will have gathered from the annual report that the Test Bar Committee have successfully completed the first part of their labours, and we are glad to learn that the new B.E.S.A. specification is based largely upon their recommendations.

(*Continued on page* 462.)

Malleable Castings.*

By W. T. Evans (Member) and A. E. Peace (Member).

(*Continued from page 426.*)

Use of Refined Irons.

Pig-irons are confined to hematite quality as the maximum phosphorus content permissible is 0.20 per cent. These irons are usually of the white and mottled grades, but vary considerably in composition. The following shows the range covered:—T.C., 3.00 to 3.80; Si, 0.40 to 1.20; Mn, 0.10 to 70; S, 0.15 to 0.45; and P, up to 0.10 per cent. In addition refined irons are largely used. The nature of the refinement is somewhat obscure but appears, at any rate in many cases, to consist of remelting the ordinary hematite irons in the cupola with the addition of steel in an attempt to lower the carbon content. Some refined irons are now made which have been considerably desulphurised, and when used with care these are very beneficial. The experience of many workers tends to show that the "refined" irons produce better malleable castings than the ordinary grades.

The pig is mixed with the shop scrap which, as indicated previously, is sufficient to supply about 50 per cent. of the charge. The annealed scrap is used by many founders to a slight extent, while others condemn it. It seems that with good practice small quantities can be used successfully, but the continued use of amounts above 5 per cent. of the charge produces metal with short life.

The losses on melting vary considerably with the cupola practice adopted and the pig-irons used. The total-carbon shows little change, although generally the tendency is towards a slight loss. The Si loss may run from 0.15 to 0.25 per cent. The manganese loss is largely dependent on the manganese and sulphur content of the charge, and there is usually very little loss, although with pig-irons of fairly high Mn. content and very hot melting, a considerable loss may be obtained, figures of 0.25 per cent. have been recorded. The gain in sulphur content depends so much upon the coke used and the temperature of melting that it is impossible to give a figure, but it may be stated that low-sulphur coke, hot melting, good fluxing, and fair manganese content in the pig-iron, favour a small sulphur pick up.

It is common practice to run two mixtures, one for heavy castings and one for light work. Usually the analysis is similar except for the Si content. Suitable compositions for both classes are :—*Heavy:* T.C., 2.9 to 3.2; Si, 0.45; Mn, 0.20; S, 0.25; and P, 0.08 per cent., and for *Light:* Si, 0.75 per cent., the other elements being similar to those used for heavy work.

Fig. 11 shows the micro structure of the hard iron from which it will be seen that there is about 40 per cent. of free cementite and 60 per cent. of pearlite. It is interesting to compare this with the lower carbon hard iron of the black-heart process.

Moulding.

The moulding of malleable castings is a fruitful source of knotty problems to the founder, some of them are common to all classes of moulding, but the majority are not met with by the founders of grey iron. Feeding, pouring, gating, etc., are very different from ordinary practice, and a casting which will present little or no difficulties in most foundries, may become almost impracticable for manufacture as a malleable casting. For this reason, purchasers of malleable will be well advised if they place before the manufacturers the drawing or design for approval before proceeding with the patterns for new work, as very often some slight change in section or design will lead to success in production.

There can be no hard and fast line for the production of satisfactory work, and only a general idea can be given, for what may seem satisfactory to-day, may from some unforeseen circumstances require changing to-morrow. That which appears here will certainly not apply in every shop.

Primarily the founder has to produce the casting from material which will satisfactorily anneal or his efforts are useless. To achieve this it is necessary to pour the moulds with irons of a low-silicon-content and in the case of black-heart with a low total-carbon content both of which shorten the freezing range. With white-heart the T.C. may be much higher, but the low silicon, together with the very much higher S. will bring about somewhat similar conditions of freezing. Therefore, there must be a high degree of superheat in the metal as poured. This high casting temperature, short freezing range, high liquid and solid contraction are a set of conditions which make the production of castings of uneven and thin sections anything but an easy proposition. But in the face of this, good, reliable, sound castings are made as will be acknowledged from the data shown of machinability to be presented later in this Paper.

It will be seen that to overcome these special conditions, the founder cannot adopt grey-iron foundry practice of running a softer mixture for the light work, owing to the fact that an iron which would give a white fracture in sections of ⅝ in. thickness, may show much free carbon in sections of 1 in. or over. It is necessary to compromise. As all castings cannot be made of one section the practice is adopted, where possible, of pouring the light castings from the air furnace early and those of the heavier types later in the heat. With cupola melting this would be the reverse, *i.e.*, the heavy work cast first. Every advantage is taken of the changes of composition which from experience are known to occur with which ever medium is used for melting, as it minimises manufacturing difficulties. Tables IV and V show changes of composition during pouring.

Generally speaking, moulds must be poured quickly, as it is necessary to fill them with liquid metal so that there is the time and temperature for the heavier parts of the castings to secure the advantage of the necessary feeders and chills. Slow pouring often causes short run and drawn castings, especially if the iron in the feeders is not hot, also it is a frequent cause of small "pin" holes appearing in the castings, the iron not being of sufficient temperature for gases to escape.

It is desirable with large castings not to admit too much iron into the mould at one particular spot, as it may so heat up the mould locally as to cause a grey or heavy mottled fracture where this has occurred. An example of this is shown in Fig. 12. Moulds should be soft-rammed consistent with the size of castings, whilst the sand should be as dry as possible with no local aggregations of red-sand. The latter together with hard-rammed and wet moulds is a prolific source of defective castings. Where trouble is found in running very thin castings, the fault may be in the use of too close a sand-mixture, and this can be remedied by the addition of sharp sands. With the use of highly superheated metal, trouble with slag inclusions is experienced, and as most of the work is cast with hand ladles the ordinary skimming methods cannot be used. These small inclusions would not be so important were it not for the after heat-treatment.

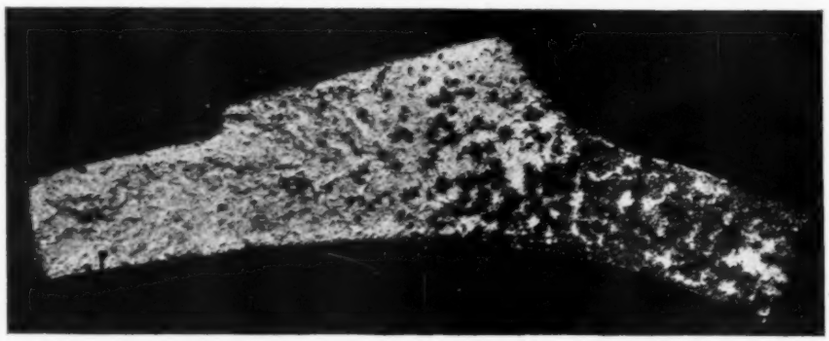
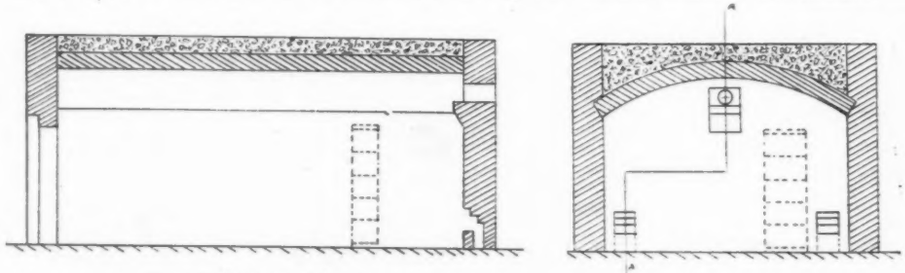


FIG. 12.—GREY TO WHITE FRACTURE IN UNANNEALED BLACK-HEART CASTING.



— SECTION A.A. —

FIG. 12A.—PULVERISED-FUEL FIRED ANNEALING OVEN.

TABLE IV.—*Analyses of Metal from a 12-ton heat on pulverised coal-fired air furnace taken at ten-minute intervals during running out.*

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
T.C. ..	2.46	2.42	2.38	2.33	2.30	2.28
Si ..	0.938	0.938	0.938	0.938	0.938	0.938
Mn ..	0.309	0.305	0.299	0.296	0.286	0.253

TABLE V.—*Analyses of Metal from a 5-ton heat on a hand-fired air furnace taken at five-minute intervals during running out.*

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
T.C. ..	2.46	2.41	2.36	2.32	2.31
Si ..	0.906	0.906	0.896	0.890	0.890
Mn ..	0.326	0.317	0.302	0.299	0.299

Common Defects.

Pulls, which are small fissures or cracks, often occur at changes of sections, or corners which have not enough fillet, or on the outside of circular plates. These must be avoided, and are often remedied by what in malleable foundries are

* A Paper presented to the Leicester Convention of the Institute of British Foundrymen.

termed "ties." These are thin sections of metal added across the position on the casting where the pull shows. This thin piece of metal sets sooner than the adjacent part of the casting and so takes the contraction strain. The tie is easily trimmed from the casting in the hard state. Cracks which may pass the hard-iron inspection are plainly revealed after annealing, opening up with expansion of the metal. Differentiation is made between hot cracks, or pulls, and castings accidentally cracked in the hard state, by the appearance of the surface of the fractures after annealing, the former having a rough or grained fracture and the latter a practically smooth face.

Cores should be made friable consistent with strength to withstand handling, and in many cases they must be made hollow, so that they readily collapse and allow the casting freedom for contraction. Sprays, horn-gates, spinners and sieve runners are among numerous methods of running adopted. A fairly representative selection is shown in Fig. 13.

Feeding.

Feeding is a most important feature and the proportion of runners and feeders to castings may vary from 30 to 70 per cent. by weight, according to the class of work and the method of production. In the spray moulding of light castings, the spray must be strong enough to carry the patterns and withstand the rapping, and in this method the proportion of sprue to castings is always high.

Wherever possible, top feeding should be avoided, as this is a source of dirty moulds, and wasteful of metal owing to the fact that the iron in the feeding head is open to the atmosphere, causing it to set quickly, which can only be overcome by increasing the body of metal.

The better practice is to fix the feeders on the joint of the mould. This involves no loss of pressure, and ensures the feeder remaining liquid until the casting has drawn from it. Cylindrical castings with flanges, particularly, are always better fed on the joint, in the root where the flange meets the body.

Special attention should be given to the facing sand. This must not be too close nor too wet. The proportion of coal dust must be carefully adjusted for different classes of work. Too much coal dust will result in miss-run castings of the lighter type, owing to the large amount of gas generated and the formation of "air locks." With metal very low in carbon and highly superheated, sand may be burnt on the castings to such an extent that they cannot be readily cleaned.

To run castings successfully with large areas of thin and intricate sections, it is an advantage to preheat the moulds and close them immediately before pouring. Where moulds are made and dried to facilitate moulding, and if there are any heavy sections, it is essential that the moulds be cold before casting to avoid grey fractures.

The illustrations, Figs. 13*a* to 13*f*, are some common examples of patterns as used in malleable foundries. The first is a spray of patterns which shows plainly what is commonly called the "spinning" feeder. This is not always the best method of running castings, as it will be seen that if the mouth into the casting is larger than that where the metal enters the feeder, there is a likelihood of dirt floating into the casting. Fig. 13*b* demonstrates the excessive weight of runner which has to be employed to hold a spray of small patterns, if any length of service is to be expected. Fig. 13*c* is an illustration of a pattern for the bottom part. The metal enters through a small perforated core, the print for which is shown at the end of the runner. Fig. 13*d* is the pattern for the top part of the same mould showing feeders fixed on the joint, also ties at either end, close to the feeder mouths to eliminate the pulls which very often appear there, due to these spots being the last to solidify. Figs. 13*e* and 13*f* are two further examples of the top and bottom halves of a pattern, showing somewhat similar methods of running and feeding, together with ties, which in this case are not on the joint of the mould.

Annealing.

Both black-heart and white-heart castings can be annealed in the same design of ovens (Fig. 12*a*), which may vary in capacity from 3 to 30 tons. Much saving of fuel can be effected by the use of special insulating material in the construction of the oven doors, such as diamataceous bricks.

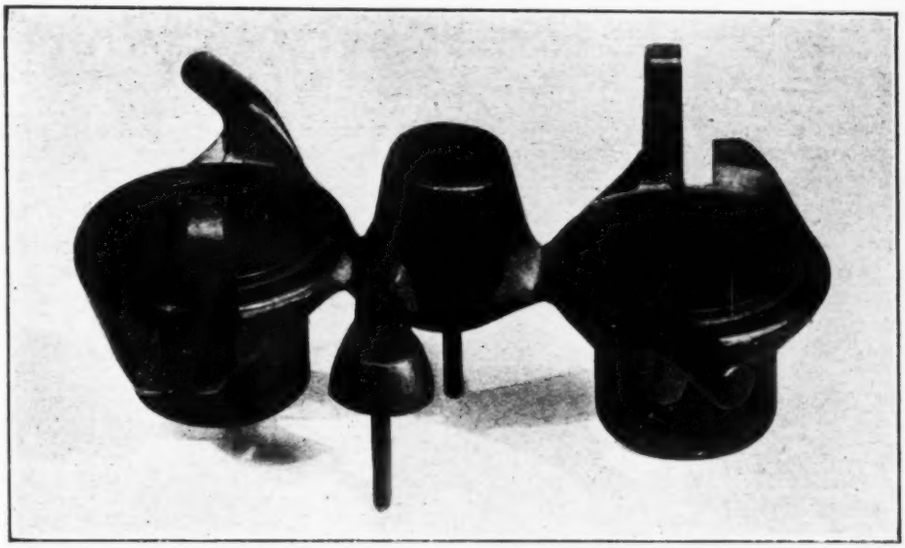


FIG. 13A.—SPRAY OF CASTINGS, SHOWING "SPINNING" FEEDER.

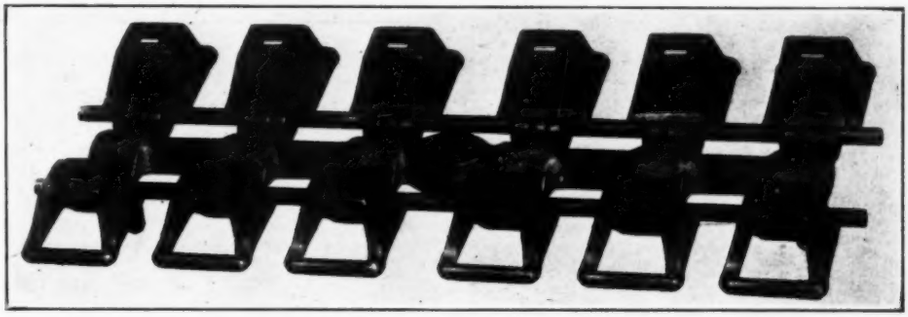


FIG. 13B.—SPRAY OF CASTINGS. NOTE THE HEAVY RUNNER.

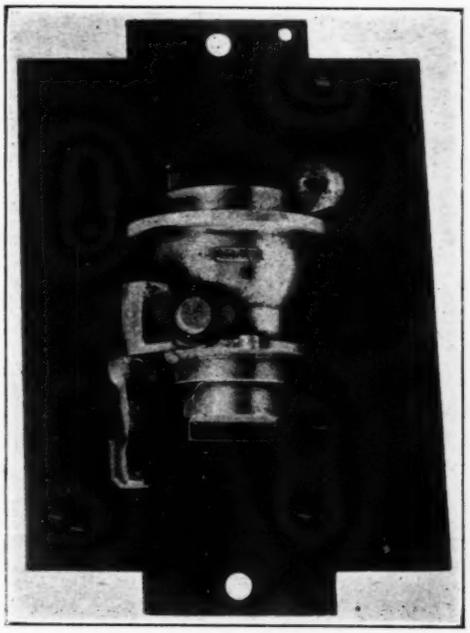


FIG. 13C.—AUTOMOBILE CASTING. NOTE THE SIEVE RUNNER.

FIG. 13D.—AUTOMOBILE CASTING, SHOWING FEEDERS ON JOINT AND TIES.

It is usual for the walls and back of the oven to be sufficiently thick, or else for the ovens to be constructed in batteries, so that there is little loss of heat incurred in this direction. The doors, however, having to be removed for each anneal are made as light as possible, and result in a very great loss of heat, unless the precaution, mentioned above, is taken. In addition, such insulation reduces the rate of cooling, which is a very desirable feature, particularly in the case of black-heart, as will be dealt with later in a discussion

on the theory of annealing. It may be pointed out that where oven doors are built up anew each time, the diamataceous bricks are too soft and firable to withstand the rough usage.

Small plants usually pack and unpack their castings inside the oven. This necessitates the oven temperature being low enough to enable men

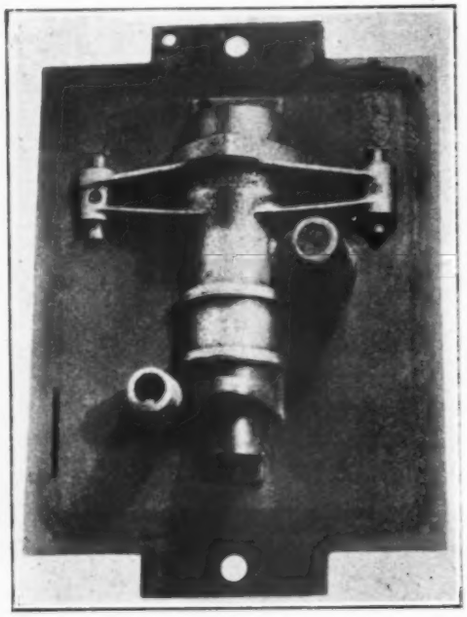


Fig. 13e.—Automobile Casting. Note the Feeders on Joint do not Come Through.

to work and handle the castings and pots before the oven can be emptied, and recharged for the next anneal. With modernised and larger plants, the pots are packed in stacks outside the ovens, and are charged with a special truck. This shows a direct saving in time of delivery and in the fuel consumption, as it is possible to draw ovens

Fig. 13f.—Automobile Casting. Note the Tie on Flange.

at fairly high temperatures and recharge in a few hours.

Annealing Pans.

Annealing pans are made of white cast iron, similar in composition to the white-heart hard castings. The useful life of these pans may be prolonged by the addition of chromium from about 0.20 to 0.60 per cent., and good results have been obtained by using metal with manganese increased to about 1.25 per cent. Nickel-chrome pans, whilst giving from 5 to 10 times the life of the hematite iron pans, are prohibitive in price, as to prove economical they would be required to give some 200 times the life of the ordinary pans.

Black-heart castings are packed in the pans with an inert material such as crushed slag, which is used to support the castings and prevent undue distortion. It also assists in protecting the castings from the oven atmosphere should a pan crack or the luting between the pans be ineffective. For castings, which by virtue of their shape and size can be closely packed without fear of warping, pans with bottoms cast in are useful. These have recessed tops which fit the bottoms of the pans so that a secure luted joint may be made. By this method packing material is discarded.

Annealing White-heart.

In white-heart annealing, the castings are packed in a similar manner, but an oxidising material is used in place of the inert material, before mentioned. This consists of hematite ores containing 70 to 90 per cent. of ferric oxide, Fe_2O_3, which during use is converted to the magnetic oxide, Fe_3O_4, and in practice generally new and old ores are mixed in the proportion of one of new to five of old. Table VI shows the analyses of some

Table VI.—*Analyses of Annealing Ores.*

Description.	FeO	Fe_2O_3	Fe_3O_4	SiO_2	CaO
New Ore. Good supply	—	90.7	—	4.7	0.85
Poor Ore. Same supply	—	68.7	—	23.8	2.00
Poor Ore	—	67.8	—	11.9	7.35
Poor Ore	1.3	71.6	—	12.3	10.3
Used Annealing Ore	—	nil	79.3	20.3	0.8

annealing ores. As this annealing process is carried out at a higher temperature than is the case with the black-heart process, the castings must be more firmly packed to prevent distortion and each casting must be in contact with the packing medium. The annealing temperature for black-heart is around 850 deg. C., and for white-heart it reaches 980 deg. C.

Relative Annealing Costs.

It will be readily seen from these figures that in the white-heart process the consumption of coal will be greater, and the life of annealing pans shorter. The amount of coal used on a pulverised coal-fired oven of 25 tons capacity in annealing black-heart is in the region of 6 cwts. per ton. With hand-firing for the same class of work the figure is about 10 cwts. per ton. No figures are available for the annealing of white-heart by pulverised fuel, but on hand-fired ovens the consumption of coal may reach 2 tons per ton of castings. Owing to the different periods of anneal adopted for various castings an accurate figure cannot be given.

The life of annealing pans in black-heart manufacture is approximately 12 heats, but in the white-heart process 7 heats is good practice. The cost of these pans is about £6 5s. per ton, and this figure must be credited with the value of the scrap pans re-sold to the makers.

THEORY OF ANNEALING.

Black-heart.

The iron to be annealed contains all its carbon in the combined form, and the structure is free cementite and pearlite (Fig. 10). This system is metastable, *i.e.*, it is stable under the temperature conditions existing, but has not reached final equilibrium. This final stable state is iron and free carbon, and is shown in Fig. 3. The condition necessary to obtain this equilibrium is the maintenance of a temperature above the lowest critical point (about 750 deg. C.) for a sufficiently long time. Above this temperature the hard iron contains austenite and cementite. In the austenite, carbon nuclei are formed, and free carbon is deposited from the surrounding austenite. The austenite maintains its carbon concentration by dissolving cementite, and this precipitation of free carbon and absorption of cementite continues until there remains a matrix of austenite and nodules of temper carbon. The austenite now graphitises, lowering its carbon content until a certain carbon concentration is reached. This concentration is definite for any given temperature, and the austenite is saturated with less carbon at lower than higher temperatures. At just above the lower critical point the solubility of carbon is about 0.45 per cent., and below it becomes practically nil.

The time factor plays a very important part. The time required to effect equilibrium at only slightly above 750 deg. C. might be 200 hours, but the reaction is accelerated with increasing temperatures, and at 1,000 deg. C. might only take 30 hours. In practice there are very strong objections to the use of high temperatures. The most important being the very large carbon-nodules formed and the coarse ferrite structure obtained. Other obvious reasons are the extra fuel cost, greater expense on oven repairs and annealing pans, and the excessive distortion of the castings. At the lower temperatures the period required is so long as to be commercially impracticable. The temperatures usually adopted are from 820 to 870 deg. C., which are maintained for a period of 50 to 80 hours, according to the temperature chosen. When equilibrium is established at these temperatures the carbon still dissolved in the iron can be precipitated, as previously explained, by lowering the temperature to, or just below, the critical point Ar_1 (about 730

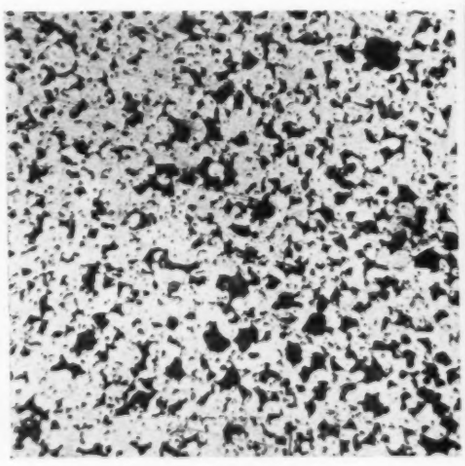


Fig. 14.—Well Annealed White-Heart. Etched × 50.

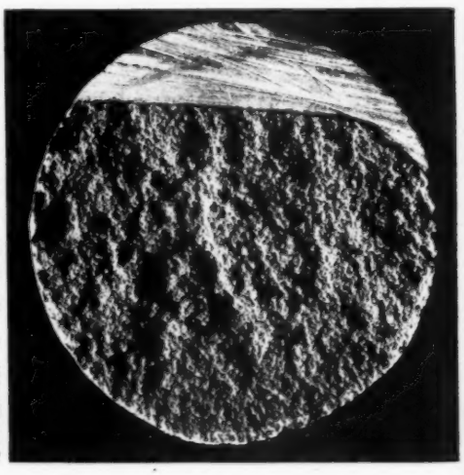


Fig. 14a.—Fracture of Annealed 3-in. Diam. Black-Heart Block.

deg. C.). It is necessary to hold at this temperature for a period to complete the graphitisation of the small amount of carbon still in solution, but in practice the normal cooling rate is so slow as to allow of the reaction being completed. This rate of cooling is less than 7 deg. C. per hour. A typical record of annealing is shown in Fig. 17.

It must be mentioned that although the packing material used is inert, a small amount of decarburisation takes place. This cannot be prevented, and is no disadvantage provided it does not proceed to too great an extent.

White-heart.

Graphitisation in the annealing of white-heart takes place in a similar manner to that just described, but owing to the higher sulphur content of this type it proceeds at a very much slower rate. The speed is so slow that graphitisation would only be complete after a prohibitively long period. As previously stated, the annealing is chiefly obtained by the removal of most of the carbon by heating in contact with iron ore. The action is twofold. It consists, in the first place, of the oxidation of carbon from the surface of the castings, and secondly the migration of carbon from the centre to the skin. The mechanism of the carbon diffusion is not properly understood, but it very definitely increases with rising temperatures. Further, at higher temperatures the affinity of carbon for oxygen is greater, so that the removal of carbon is more rapid the higher the temperature. Also the removal is more rapid in the initial stages, when new ore is used. It will be appreciated from these remarks that it is possible to have a rate of oxidation at a certain temperature which is faster than the carbon diffusion at that temperature. Such a condition of affairs often exists, and this is the main reason why all new ore is unsatisfactory in use. The new ore is so vigorous in its action that it removes the carbon quicker than migration takes place, and when there is no more carbon in the surface for it to oxidise, it oxidises the iron forming a network of oxide round the ferrite grains. Such oxidation is a contributory cause to "peeling."

Commercial considerations determine that the annealing temperature shall be from 960 to 980 deg. C., and the period at this temperature approximately 100 hours. Both the temperature and time may have to be varied for different size and thickness of castings, and for very heavy sections double and even treble annealing periods are given.

Assuming the given explanation of annealing white-heart to be somewhere near the truth, it will be apparent that to remove the carbon to the same extent in the heavy parts of an uneven sectioned casting a more active oxidising medium will be required adjacent to such sections. This is one of the chief reasons why malleable castings should be made of as uniform thickness as possible. A thickened portion may add strength but not ductility. With well-annealed white-heart, the carbon is removed to such an extent that the remainder has, during the period at heat, practically all graphitised, leaving from 0.30 to 0.80 per cent. of combined carbon. This is shown in Fig. 14.

(To be continued.)

Iron and Steel Output in May.

The National Federation of Iron and Steel Manufacturers report that the number of furnaces in blast at the end of May was 148, a net decrease of one since the beginning of the month, 2 furnaces having gone into blast, and 3 having ceased operations. Production of pig-iron in May amounted to 591,500 tons compared with 563,100 in April and 720,100 tons in May, 1927. The production include 193,000 tons of hematite, 208,900 tons of basic, 139,100 tons of foundry, and 27,700 tons of forge iron. The production of steel ingots and castings in May amounted to 752,700 tons compared with 644,100 tons in April and 884,600 tons in May, 1927.

PALMERS SHIPBUILDING AND IRON COMPANY, LIMITED, Jarrow and Hebburn, have booked orders for three twin-screw oil tankers of 4,300 tons for Sir Joseph W. Isherwood & Company, Limited.

Grading the Job to Ensure Equitable Payment.

By W. J. HISCOX.

The news that the Amelgamated Engineering Union has at length withdrawn its opposition to the principle of payment by results has been hailed with enthusiasm in many quarters, and opinion has been freely expressed that a formidable obstacle to peace in industry has been removed. As a matter of fact, however, the opposition of the Union has for a long time been a minus quantity, and the withdrawal of the embargo is simply a graceful way of retreating from an untenable position.

The rank and file have for long been in favour of payment by results as being the only way by which wages could be augmented, and the only opposition coming from that quarter has been occasioned by alleged unfair methods of fixing rates. It will be noted that the Union now announces its intention of obtaining some control over these, and it will be interesting to see whether its activities in this connection will bring about a more equitable state of affairs.

Will it still require day-work rates to stand as the basis of piece-work earnings, or will it favour the abolition of these, and seek to establish a grading system of payment, in accordance with the importance of the work done and the degree of skill necessary to do it? Will its influence result in justice being done to the skilled workman, and encourage youngsters to qualify for the higher branches of the trade?

There will be no peace in industry until the skilled man is encouraged and gets his just desserts, for in spite of the rapid progress of standardisation and specialisation the skilled mechanic is still an important factor, and the industry cannot progress without him. The semi-skilled and specialised worker may be able to produce in quantity and thus cheapen production in certain directions, but he must be provided with the requisite facilities, and even then there are production jobs that he cannot undertake.

As a man gains in proficiency, so is his value to the firm increasing, and his earnings should rise in proportion. The failure of the piecework systems in this country to get the costs of production low enough to stimulate the demand for manufactured goods is due to the fact that the skilled artisan is deliberately left outside. He is retained to do the intricate work, but he is not given a bonus for doing it, and his earnings compare very unfavourably with those who undertake the more simple tasks.

But even in the case of semi-skilled and specialised workers there are anomalies which prevent the piecework system being a success. In most works the system is a patchwork affair, which not only excludes the skilled man, but also brings into one category workers of different values. In every part of the factory will be found good, mediocre and bad workers engaged upon similar work, and while one man can earn a substantial bonus another has difficulty in earning this day rate. The progress of the proficient worker is in these circumstances retarded by the ineptitude of the slow worker, and the firm is the loser.

In general the piecework and bonus systems operating in this country are inefficient and wasteful, and will be so until a proper system of job grading is introduced, and day rates are abolished. The day rate acts as a curb on progress, and while it is in existence there can be no talk of maximum production. A man whose day rate realises £3 a week is more than satisfied if he earns on piecework £4 a week, yet he may be capable of earning £5 or even more. On the other hand, the employer argues that if a £3 a week man can consistently earn £5 a week the rates are too high, and the steps taken are such as will discourage the workman and limit production. This is not the way to cheapen production. The only way to do this is to get every man in his right category, so that he is full value for what he earns.

To do this the jobs must be graded, and the more skill that is necessary to accomplish the job the more valuable must the job be, from the firm's standpoint. In the factory there are jobs for beginners, for juniors, for specialised workers of varying degrees, and for skilled artisans, but every job must be a paying proposition. If the job is worth £1 expenditure in wages then £1 must be paid for it, to the worker to whom £1 is a reasonable reward. In other words, each worker should have the opportunity of earning a weekly wage proportionate to his experience and proficiency, and the firm must make a profit on the deal.

The grading of jobs need not be in accordance with the operations, as, for example, all turners in one grade, all drillers in another, and so on, because, while some turning or some drilling jobs are simple enough to be included in one of the lowest grades, others may call for the services of the skilled artisan or a highly specialised worker. Thus in each grade there would probably be turning, milling, drilling, grinding, and other operations, but each job must be considered on its merits and consigned to its correct category.

It has been suggested that day rates should be abolished, as being inimical to enterprise, but the weekly earnings of the worker must be safeguarded, and this is effected by means of a grade minimum. At the present time the day rate represents a guaranteed weekly wage, and no matter how low the actual earnings are the wages of the worker cannot fall below this amount. Thus, if it becomes apparent to the worker that he cannot earn anything above his standard wage during a certain week he is not disposed to extend himself, because he knows that, no matter how little he does, he is assured of his standard wage at the end of the week.

The grade minimum, on the other hand, has to be earned if the worker is to keep his place, and he has got to complete a given amount of work during the week to do it. This minimum is much higher than the standard wage, and may be represented as being the standard wage plus a predetermined amount as bonus. At the present time the man gets his standard wage in any case, and also a bonus, if he earns it, but the grade minimum is a predetermined wage and bonus combined, which must be earned.

The following table shows the various grades which should operate in the average factory, together with a suggested grade minima (in round figures) and present-day standard wages, for comparison purposes:—

Grade.	Workers' Classification.	Standard Wage. £ s. d.	Minimum Grade Earnings £ s. d.
1	Beginners (14-16) ...	0 15 8 ...	1 0 0
2	Juniors (16-18)... ...	1 7 5 ...	2 0 0
3	Youths (18-21)... ...	1 19 2 ...	3 0 0
4	Specialised workers (B)	2 7 0 ...	4 0 0
5	" " (A)	3 2 8 ...	5 0 0
6	Skilled artisans ...	3 19 2 ...	6 0 0

If a worker in any grade fails to earn the minimum allotted to that grade he loses his position and must be relegated to a lower grade, but if he consistently rises above the minimum he is promoted to a higher grade. This will ensure that there will be no marked disparity in the earnings of men engaged upon similar work, for, as already mentioned, while the minimum can be earned it has to be worked for, and the man in grade 4, for example, must be an exceptionally proficient worker to consistently earn £5 a week. If he does achieve this it is proof that he is too good for the category in which he is placed, and as a consequence he is promoted, so that he can earn probably more than that amount, and become a more valuable producer.

Such a scheme as this would do much to encourage the young worker to qualify for promotion, for the higher he gets the more his earnings will be, and it will pay him to become a skilled artisan. It means, of course, that production planning must be much more thorough than it is, but it is the only way to get costs down to rock bottom. The present method of fixing piece rates on day rates is uneconomical, for it but scratches the surface, and does not get down to the root. If the Union will support such a scheme as this it will not only be acting in the best interests of the workers, but in the best interests of the industry, and its intervention will be fully justified.

Aluminium Casting Alloys.*

A REVIEW OF RECENT PROGRESS.

By George Mortimer (Member).

(*Continued from page 437.*)

Foundry Precautions.

From routine foundry observation "Y" alloy appears to possess higher solidification shrinkage than that common to the other alloys of the B.E.S.A. range, and the effect of this is enhanced by the fact that the pouring temperature for "Y" alloy is often 30 or 40 deg. C. higher than that normal, say, to 3L11. Castings have a distinct tendency to cracks and draws, and to counter this tendency it is necessary, either to feed heavy sections by very ample risers, or to force them to freeze more quickly by using heavy chills. In choosing which method to employ there is only one answer where the castings have to be heat-treated, because the results of the heat-treatment hinge so largely on initial solidity of structure and refined grain. As stated earlier, slow solidification results in excessive grain size and porosity fatal to the best results, and the aim should be to approach the conditions met with in a chill-cast automobile-piston or a test-bar. The further one departs from this ideal the less satisfactory the results, as can be seen in Table II giving average properties after heat-treatment.

This is a point designers might well note. Sections much over ¼-in. or ⅜-in. thick in a sand casting might in many cases be split up with advantage. Two well-designed ribs ⅜-in. thick may be stronger after heat-treatment than one section an inch thick.

TABLE II.

	Y. P. Tons/sq. in.	M. S. Tons/sq. in.	E. Per cent.	Brinell.
1 in. dia. chill	16	20	4.0	115
½ in. dia. sand	13	16	1.5	107
1 in. dia. sand	12	14	0.5	105

One other inherent foundry difficulty associated with "Y" alloy is due to the relatively large percentage of magnesium used, a metal notorious for its affinity for oxygen and its sensitiveness to moisture. The formation of magnesium oxide is to be avoided, since it passes into the casting in the form of flakes and drossy lace-work which shows up in small patches on machining. Such patches are not necessarily "hard spots," but they have a tendency to take the finer edge off the keen tools used in modern high-speed machining, and they also advertise themselves as a casting defect and spoil the saleability of the work.

To meet this tendency it is wise to avoid all unnecessary disturbance of the melt once the magnesium has been stirred in. The creamy scum on the surface can be left alone until just before pouring, when it should be removed with meticulous care, the melt stirred with as little disturbance of the surface as possible, and again skimmed. For the best class of work transport the actual melting pot to the mould, and always arrange for gates which cause as little turbulence to the incoming metal as is possible, with no direct drop to the bottom of a deep mould. The writer has found it useful to play a jet of carbon dioxide, sulphur dioxide, or even the flame of an ordinary gas torch into the mould during or just prior to pouring.

It follows from the sensitiveness of magnesium to moisture that all chills should be dry, and it is advisable to keep moulds open until the last moment in the case of green sand, and to keep chills just warm.

One final trouble the founder is likely to meet is also bound up with the magnesium content, and with the difficulty of making castings in any metal which are entirely impervious to penetration by gases during long periods of heat-treatment. If a large sand casting of "Y" alloy is machined up prior to heat-treatment, the machined face will generally show a fine, silvery surface, free of blemish. If another is taken from the same batch and heat-treated and then machined, it will often be found that gases have penetrated an apparently sound and solid casting, and caused the magnesium compounds therein to show up as unsightly grey spots or patches. The presence of such defects appears to have little practical effect on the tensile figures; there are probably minute gas cavities or discontinuities in all castings. The difficulty lies in the fact that magnesium develops such academic defects like the sensitive collodion of a photographic plate and advertises their presence, to the detriment of the sales value of the casting. This class of defect is absent in the case of die castings or heavily-chilled sand castings, and it is possible that it may be entirely eliminated in normal commercial work by using electric muffles for heat-treatment filled with a gas which has no effect upon aluminium or magnesium. If it were possible to cut down the magnesium content or to eliminate it, 50 per cent. of the foundry troubles of "Y" alloy would automatically disappear; but it would then cease to be "Y" alloy.

Heat-Treatment of "Y" Alloy.

The standard treatment for chill castings and for sand castings of fairly light section is as follows:—(a) Soak for 6 hrs. at 510 to 520 deg. C.; (b) quench in boiling water; and (c) either set aside to "age" for at least five days, or retain in the boiling water for one hour.

"Y" alloy, like all the heat-treatable alloys containing magnesium silicide, will age spontaneously at room temperature, given time. The alloys based on CuAl$_2$ only, or with silicon added as in the case of Lautal, do not readily age at room temperatures. This is in some cases an advantage, as heat-treatment and quenching may be done by the founder, and the annealing operation only carried out by the user after the bulk of machining has been done on a relatively soft material.

For die-cast pistons and for small sand castings of light section the period may be cut down materially. Mr. S. Daniels, of the Army Air Service Research Department, McCook Field, Ohio, states that soaking for one hour only at 510 deg. C., followed by quenching in *cold* water and one hour at 235 deg. C., produces in "Y" alloy properties which fulfil the requirements of the U.S. Air Service Specification 57-72-1. In the author's experience a chill-cast bar 1-in. diameter will give 20 tons with fair consistency after one hour only at 520 deg. C., followed by quenching and normal ageing, and sand castings with sections not exceeding ¾ in. may be so treated with economy. The longer treatment will, however, always give rather better and more consistent results.

One point of interest to founders supplying castings for use at high temperatures may be mentioned. If instead of ageing at 100 deg. C. the temperature is maintained for an hour or two at from 150 to 200 deg. C., the physical properties *at high temperature* are markedly improved, though the test-bar figures at room temperature may show no change.

For Diesel-engine pistons, which may weigh 600 to 700 lbs. per casting, with sections from 2 to 3 in. thick in the head, soak for a minimum of 48 hrs. at from 510 to 515 deg. C., quench in olive oil, moving the casting slowly up and down in the bath for 30 minutes or so until temperatures are equalised, and allow the casting to age in air for eight or ten days.

Treatment temperatures must be steadily maintained without break or fluctuation; if it is decided to give a medium-heavy sand casting twelve hours' soaking, it must be twelve hours on end; it is fatal to divide the period into two six-hour shifts with an interval between. Reliable pyrometers are essential, but for simple work in foundries not possessing up-to-date heat-treatment plant, much may be done with a bath of fused nitrate of sodium and potassium in equal parts over an ordinary gas burner, which will check sudden rises or falls in temperature.

Modification.

Developments under this head of interest to the founder are chiefly confined at the moment to the well-known silicon alloys, known in Germany as Silumin, and in this country as Alpax or Wilmil.

The principle of "modification" has been described very prolifically in the technical press in recent years, and many theories have been advanced in explanation. The latest and most exhaustive work on the subject is that of Gwyer and Phillips,* whose theory appears to bear most tests the logical mind can impose. Expressed at its simplest, this theory is that during the process of solidification, whilst particles are passing from atomic dispersion to the crystalline state, they must pass through some point at which the silicon and aluminium aggregates are of colloidal dimensions. If some reagent is introduced into the melt which will check the further coagulation of such colloidal particles, the normal growth of crystals is inhibited. In the case of the silicon alloys the addition of an alkaline metal, an alkaline-earth metal, or their compounds, appears to have this effect of a "colloid protector," and the effect is seen in the micro-photographs (Figs. 5 to 8). The effect on the physical properties may be gauged from the following figures.

If 13 per cent. of metallic silicon is added to aluminium the tensile properties are much as follows:—

M.S. tons per sq. in.	E. per cent. on 2 in.
6 to 8.	0.5 to 1.25.

If before pouring, an alkaline earth metal, such as sodium, be added to the melt, the properties are changed at once to:—12 to 16 tons, with 7 to 15 per cent. elongation.

With these enhanced tensile properties is obtained an extremely refined, silky structure, so that fractures of the modified alloys more resemble those of forgings than castings. The alloy so treated has many other useful features. It is abnormally malleable in the cast state, and castings may be bent and hammered through surprising angles without fracture. It is abnormally resistant to corrosion by sea-water, and it is rather lighter than pure aluminium itself. The alloy can be welded readily without a flux, and the weld zone is generally stronger than the rest of the casting because of two factors. Firstly, the elongation of the material is very high at high temperatures, so that undue stresses are not set up by the local heating and cooling; secondly, the best physical properties are brought out by abrupt chilling, and this is just what one gets in welding a casting, whether it is wanted or not.

It is not too much to say that this development, the work of Dr. Aladar Pacz, is the most important of all advances in light metallurgy in recent years, and although the silicon alloys have been known as long as aluminium itself, the silicon alloy as we know it now is one of the very few new alloys of note produced since the war. Apart from the useful fields in general engineering, and particularly in marine engineering, opened up by the modified silicon alloys, the possibility of applying the principle to other metals and alloys has been demonstrated by Gwyer, and this mere possibility opens up new and attractive vistas for investigators.

Bearing in mind the essential point in the heat-treatment of light alloy castings, the finest grain obtainable, and the difficulty of obtaining a refined grain in large sand castings, the possibilities of heat-treatment in the case of the ultra-microscopic grain of the "modified" structure are of considerable interest. The straight silicon alloys themselves are not susceptible to heat-treatment from the practical standpoint, but the ternary aluminium-silicon-copper alloys are becoming popular, and there is always the possibility that some investigator may evolve a reagent for the modification of "Y" or similar alloys. The

* A Paper read at the Leicester Convention of the Institute of British Foundrymen.

* "The Constitution and Structure of the Commercial Aluminium-Silicon Alloys." By A. G. C. Gwyer, B.Sc., Ph.D. and W. L. Phillips, B.A., A.I.C., "Jour. Inst. Met.," 1926, No. 2.

addition of small percentages of beryllium has already been mooted in this connection.

In practice the use of sodium fluoride, hydrate, and other compounds is gradually giving way to the more convenient metallic sodium, a small percentage of which is wrapped in foil and thrust to the bottom of the melt.

Any founder can cast silicon alloy without apparent difficulty; there is no alloy on the founder's repertoire so free from hot-shortness or any of the troubles normally associated with light alloy founding. The shrinkage is low, and the elongation at solidification point very high; cracked castings are unknown. The metal is remarkably fluid, and will flow into very thin sections, lettering, etc., with excellent definition.

It is equally safe to say, however, that there is no one alloy so likely to let the inexperienced founder down in regard to internal structure, soundness and strength. "Y" alloy has its troubles, but the majority are obvious to the founder before the casting is despatched to the customer. In the case of the silicon alloy the troubles are less obvious; the castings turn out of the mould with a finish and accuracy of definition which will surprise anyone accustomed only to the normal run of light alloys, the usual

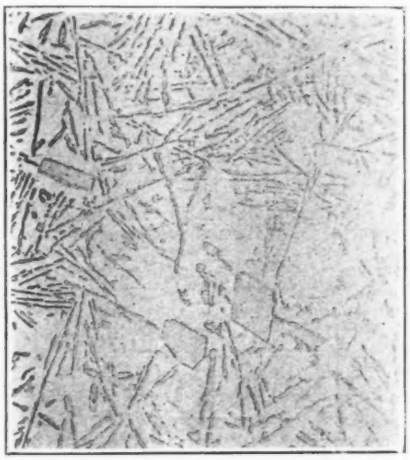


FIG. 5.—13.40 PER CENT. SILICON, 0.08 PER CENT. IRON. CHILL CAST. UNETCHED. × 200.

standard chill-cast bar from the same melt gives high tensile and elongation results, and the castings go forward to their destination, despatched in perfect good faith. If they have been produced in a foundry unaccustomed to this alloy, however, they may have a whole host of hidden defects, ranging from a crystalline, weak structure to cavities the size of a walnut. The content of iron, the percentage of modifier used (which causes trouble either if too high or too low, and which is chosen according to the amount of scrap used, the analysis of the melt, and even the size and design of the casting), the temperature of the melt, the time of pouring after modification, all have their effect on the properties and structure of the casting itself, whatever results are obtained on a chilled bar from the same melt. In no alloy is the accepted standard chill-cast bar so unreliable a guide to the state of things in the casting; it is quite possible to go from one year's end to another passing the acceptance tests with bars which have been cast in ice-cold chills, and with metal on which no modifying agency has been used at all; but the castings in that case would possess very low and unreliable properties. This class of alloy in reality calls for a further check on the actual casting, in the form of a sand-cast section an inch thick, connected to the casting by a ½-in. neck. If the "authorised inspector" broke this coupon off himself, the fracture would indicate the nature of the properties likely to be found in the casting; the fracture must be white and silky, not coarsely crystalline.

The silicon alloys as modified are protected by numerous patents, and founders who contemplate adding them to their list of standard products may save much worry and cold cash by acquiring a licence, with which goes much accumulated experience and information. The royalty is the premium one pays for insuring consistent workmanship, and it is probably the cheaper way. It is, at any

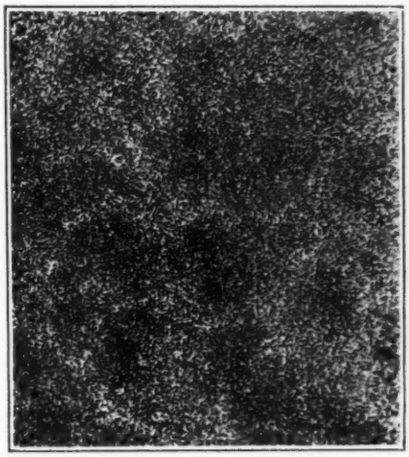


FIG. 6.—13.40 PER CENT. SILICON, 0.08 PER CENT. IRON. SAME ALLOY AS FIG. 5, BUT MODIFIED WITH 5 PER CENT. NaOH AT 750 DEG. CHILL CAST. ETCH H.F. × 200.

rate, a way which at once places the novice to this material on a par with those who have borne the burden and heat of the day, and enables him to fulfill his contracts without costly experimentation or anxiety.

The simple addition of silicon to ordinary foundry alloys is one of the useful side issues of the growing popularity of silicon alloys. The addition of from 1 to 1½ per cent. of silicon to any standard alloy has a marked effect on its foundry properties, in reducing the tendency to draws and cracks, and in giving better definition. Every

FIG. 7.—9.86 PER CENT. SILICON, 0.45 PER CENT. IRON. CHILL CAST. UNETCHED. × 200.

founder knows, for example, the range of troubles associated with a rise in the iron impurity content. If silicon is added to exceed the iron by 25 per cent., this range of troubles subsides, and it becomes possible to use up collected sculls from pots, and other low-grade material, and cast it without difficulty into loud-speaker horns and similar unstressed work.

PROTECTION.

The question of corrosion is nowadays not quite the bogey it used to be, when the standard of aluminium supplied to commerce was not so consistently high, nor its alloying and handling so well understood. There are conditions on seaplane or naval work, however, which call for some protection in the case of aluminium as in the case of iron. There are many paints, collodion lacquers and varnishes which offer good protection as long as the coating is kept intact. Strange enough one of the soundest protective paints of this class is aluminium paint, long known as a protective against corrosion for such parts as lamp-posts and tramway overhead equipment, especially in sea-board towns. Recently aluminium paint, especially when sprayed on, has been found of definite protective value in connection with aluminium castings.

Lanoline.

It is generally found that in the engine rooms of ships, aluminium castings can be left unprotected, whichever of the standard alloys is used, because of the film of oil always present. Lanoline is one of the cleanest and most tenacious grease films, and castings may be dipped in hot lanoline and wiped down as a preliminary to painting. Castings coated thus have withstood exposure at half-tide with no paint or further protection for ten months or a year.

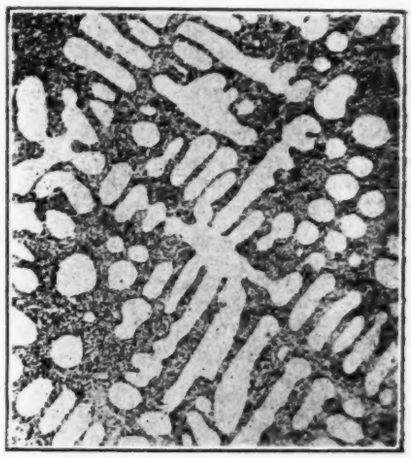


FIG. 8.—9.86 PER CENT. SILICON, 0.45 PER CENT. IRON. SAME ALLOY AS FIG. 7, BUT MODIFIED WITH 5 PER CENT. NaOH AT 750 DEG. CHILL CAST. ETCH H.F. × 200.

Sodium Silicate.

If castings are soaked in water glass (specific gravity 1.1) for a couple of hours, followed by baking at 120 to 175 deg. C., they exhibit a marked resistance to sea-water corrosion. This is a good preparation for subsequent painting, and it is one which is applied without special apparatus in the foundry. The process was developed by A. C. Zimmerman and S. Daniels at the McCook Field Research Laboratories, and is known as the "Z-D Process."

Anodic Oxidation.

This is the most effective of all methods of protection, but is itself protected by British Patents Nos. 223,994 and 223,995, and it calls for a certain amount of special apparatus. The process consists in making the casting the anode in a 3 per cent. solution of chromic acid; voltage is slowly raised from 0 to 40 volts in 15 min., and the latter tension is held for 35 min.; it is then raised to 50 volts for five minutes, and the casting is taken out and washed. The result is an extremely thin and tenacious film which for all practical purposes inhibits corrosive action. A dressing of hot lanoline further assists matters, and the film cannot be removed except by sheer mechanical abrasion. Obviously this method is more applicable by the customer after all machining has been carried out, but founders who wish for further details on this and other electrolytic protective devices cannot do better than refer to the Paper by H. Sutton, M.Sc., and A. J. Sidery, Assoc. Met., published in the "Journal of the Institute of Metals," 1927, No. 2.

Spontaneous Protection.

Protective methods so far referred to are deliberately applied, either mechanically or electrolytically. Certain metals and alloys have the property of self-protection by the spontaneous formation of the necessary film. Aluminium itself would corrode with extreme rapidity were it not for the oxide film which instantly forms on its surface Stainless steel owes its stainless record to this phenomenon, and both aluminium-brass and aluminium-bronze owe to the film-forming propensities of aluminium their unique resistance to corrosion. This protective film can be very materially strengthened in the case of aluminium castings simply by baking them in a core oven for an hour or so at round about 180 deg. C., a recent discovery of practical value to founders because of its simplicity and the useful degree of protection obtained.

Attention is being now directed to the possibility of introducing some element into aluminium alloys which will automatically enhance this property. It is possible that silicon has some such effect; castings exposed to half-tide in estuaries have shown little or no corrosion of practical import after over a year's exposure, and their after appearance has much resembled that of an anodically oxidised specimen. Recently the effect of very small percentages of antimony has been studied in Germany, and this is the basis of the K.S. Seawater alloys, of which it is claimed that they spontaneously develop a film of high protective value which is automatically replaced on abrasion.

Summary.

It is hoped that this review will give a fair perspective of the lines on which aluminium-alloy founding has progressed in the past few years, and is progressing now. The author has treated the subject with reserve throughout, because it is recognised that the utmost it is safe to claim is that our feet are set on the path.

Yet, if a true perspective is to be gained of the genuine scientific advancement of recent years it is necessary to go back to the year following the close of the great war. At that time "speckled metal" was regarded as a necessary evil; heat-treatment, as far as castings were concerned, was a laboratory term; neither "modification" nor protection had been heard of. To-day large numbers of melts are treated daily by pre-solidification, and enormous numbers of castings are scientifically heat-treated as a matter of routine. Results do not always tally with those of the laboratory poured and treated bar, and often they cost too much, but they do attain a standard of soundness and strength which on the whole justify the cost. Hundreds of tons of modified silicon-alloy castings are produced on routine lines annually, and large numbers find their way into marine uses in exposed positions. When protection is called for, many founders are in a position to offer it as a matter of routine. It will be seen that the past decade can show concrete evidence of progress, none of which would be obvious to the casual visitor to any modern despatch department.

Visitors not in touch with the industry tend to overlook one very significant point. Only a few years ago quite 90 per cent. of a normal foundry output in aluminium castings went to the motor industry. To-day a normal output may cover an amazing diversity of engineering and industrial interests, whilst designs and scantlings are reduced to a point which, to the discerning, can only mean one thing. Both the materials now available, and the methods employed in their founding, have resulted in the increased confidence of engineers in the capabilities of aluminium-alloy castings for strenuous and reliable service, in competition with materials of inherently higher physical properties.

Errata in Paper on "Malleable Castings."

Two misprints crept into Part I of this paper. They are (1) that in the first table referring to the B.E.S.A. specification, 90 ft. per min. is also the machining speed for Blackheart malleable, and (2) under the caption "losses sustained" (col. 3, third line from bottom) the sulphur should read 0.045 per cent.

Colorimetric Methods in the Foundry Laboratory.

Efforts are now everywhere being made to improve the quality of cast iron by the addition of various other metals. Control of carbon content and of the form of the carbon has hitherto called for the continual services of the chemist, and it is plain that the new processes cannot be carried out at all without such chemical supervision.

Dr. Hugo Freund has given in "Die Giesserei" (1928, No. 6) some particulars regarding the reactions and procedure employed for colorimetric determinations that have been in use for a considerable time in German iron and steel works and which recommend themselves for the foundry laboratory—particularly where routine analyses are concerned.

Determination of Combined Carbon in Pig Iron and Cast-Iron.

The characteristic brown colouration produced by the combined carbon on solution of the iron in chlorine-free nitric acid is utilised (Eggertz process). This method, which had formerly been used only for steels, was comparatively recently advocated by Burford and Baader for carbon estimation in cast iron.

One gram of pig-iron or cast-iron drillings are dissolved in a 100 cc. graduated flask in 20 ccs. nitric acid (sp. gr. 1.20) by warming in a water bath. After about 20 minutes the water bath is more strongly heated, and boiling is continued until evolution of gas ceases. Upon cooling, 25 ccs. of 30 per cent. caustic soda solution are added, whereupon ferric hydroxide is precipitated, bringing the graphite and silica with it. The flask is then filled up to the mark, shaken and cooled. It is then once more made up to the mark and the precipitate allowed to settle.

The clear liquid is now compared in the colourimeter with a standard solution which is freshly prepared each time, from a standard steel with known content of combined carbon, simultaneously with the solution of the sample under investigation.

As mentioned, the process has long been in use for determination of the carbon contents of steels—both ordinary carbon steels and alloy steels—and, according to Kropf, one can use for comparison purposes, in place of the standard steel solution which must be renewed each time, solutions of caramel, which are standardised against standard steels and can then be kept for a considerable time.

Determination of Manganese.

When 2 per cent. silver nitrate solution is employed, divalent manganese can be oxidised even in the cold—without precipitation of the dioxide—to permanganate. As oxidising agent, there is utilised ammonium persulphate, and the maximum colour intensity is developed in about 5 mins.

Approximately 1 gm. of pig-iron or cast-iron drillings are dissolved (with the aid of nitric acid) and made up to 250 ccs. Of this solution, 50 ccs. are taken, and to them are added, in a 100 cc. graduated flask, 10 ccs. silver nitrate solution and 10 ccs. ammonium persulphate solution. The contents of the 100 cc. flask, heated till they begin to boil, are now cooled, and the flask filled up to the mark. If silver chloride separates it is filtered off. The standard solution for comparison is obtained from a steel of known manganese content, treated in the same way. The solutions will not keep for long.

The silver nitrate solution contains 5 gms. in 1,000 ccs. water; the persulphate is in 10 per cent. solution.

Determination of Copper.

For the colourmetric estimation of copper, the deep blue colour produced in copper solutions by addition of ammonia in excess is made use of. As the colour depends on the nature of the solution and on the quantity of added ammonia, the solution to be tested and the standard solution for comparison must be made up in exactly the same way.

Five grams of iron are dissolved in hydrochloric acid, the solution diluted, and the copper precipitated at a moderate temperature as sulphide. The copper sulphide is filtered off, washed, and dissolved in warm hydrochloric acid. A definite quantity of ammonia is added to the solution and the latter then made up to 5 or 100 ccs. The solution for comparison consists of 2.115 gms. cupric chloride in 1,000 ccs. water; this contains 0.1 mgm. copper per cc.

Determination of Titanium.

The colourmetric determination of titanium is based upon the yellow colouration imparted to a solution containing titanium by hydrogen peroxide. This sensitive colour reaction renders possible the quantitative estimation of the smallest amounts of titanium in pig-iron, etc.

The pig-iron is best dissolved in a mixture of sulphuric and phosphoric acids (900 ccs. sulphuric acid, 1: 5, to 100 ccs. phosphoric acid, Sp. Gr. 1.20). For 1 gm. of iron, 20 ccs. of the acid mixture usually suffice. When solution is complete, the liquid is diluted with water to 50 ccs., cooled, and 10 ccs. of concentrated hydrogen peroxide are added.

For comparison there is employed a solution of titanium-free pig-iron to which has been added a definite quantity (roughly corresponding to the sample to be analysed) of titanium sulphate solution, prepared as follows:—

0.6003 gm. of pure titanium potassium fluoride are, after gentle ignition, evaporated a number of times with sulphuric acid and then dissolved in a little concentrated sulphuric acid. The solution is diluted with 5 to 10 per cent. sulphuric acid, oxidised with 2 to 3 ccs. hydrogen peroxide and, after addition of 4 c. to 50 ccs. phosphoric acid (sp. gr. 1.30) diluted to 1,000 ccs. The resulting titanium sulphate solution contains 0.00016 gm. Ti per cc.

The author concludes by recalling the fact that chromium, nickel and sulphur can also be quantitatively estimated by colourmetric means. He gives some references to the literature, covering both these elements and those dealt with in the present article.

Conference Asides.

Things we want to know:—

The name of the Scottish delegate who has visited every tramway terminus in Leicester.

Whether salt and pepper constitute an ideal hair restorer.

Who won the dancing competition for which the first prize was understood to be a Morris.

Who took an officer's name in vain during the visit to Leys and whether the perpetrator achieved more success as shunter.

Why the London delegate could not find his "spouse."

What was the attraction in the left-hand corridor by the side of the platform at the De Montfort Hall.

Who was miles behind in the production of a workmanlike corkscrew.

We regret to record the death of Mr. Edward Mitchell, who was for many years works manager to Messrs. George Oxley & Sons, Limited, Vulcan Foundry, Attercliffe, Sheffield.

We deeply regret to announce the death of Mr. W. J. Tarrant, the managing director of the Dorset Foundry Company, Limited, Poole, which occurred at an hotel in Leicester on the opening day of the Institute of British Foundrymen Conference. Mr. Tarrant was eighty-two years of age, and had attended each Convention since 1925, the year he joined the Institute.

Theory or Practice in Grey-Iron Foundry.*

By John Shaw, Southsea.

(*Continued from page* 435.)

Exhaustive Study a Great Undertaking.

The question naturally arises, how is it no serious attempt has been made to study the effect of each element on a base material containing the other elements in the lowest proportions found in cupola metal? The simple fact is the investigation is too large for any one university to undertake. After all, their object is to educate; any special research can only be undertaken by post-graduate students or those who receive a special grant. Even the British Cast Iron Research Association could not hope to undertake it without exhausting both the patience and the interest of its members. The position is best summed up by the late Professor Jeremy Porter: "If each of the six elements is varied in only seven proportions, and each resultant metal tested by each of the twenty physical properties, 2,352,980 different experiments would be required."

At the same time it might be possible with the aid of the universities situated in grey-iron centres (Birmingham, Sheffield, Manchester, Newcastle and Glasgow), together with the help and supervision of the British Cast Iron Research Association to tackle the problem in a modified form. There is

TABLE X.—*Suggested Basis for Research on C.I.*

	T.C.	Si	Mn	S	P
Suggested base material ..	2.5	0.5	0.5	0.03	0.3
Suggested increases	3.0	1.0	0.8	0.08	0.8
	3.5	1.5	1.1	0.11	1.1

no difficulty in obtaining an iron containing the lowest content of each element found in any casting. This would not vary from end to end of the pig bed by anything like the amount given in several of the investigations using a synthetic base (Table X).

Cast Irons Cover Wide Range of Combinations.

If each element is varied in three proportions, as shown, this would cover nearly all the high-test irons. The low-silicon and low-carbon combinations would require to be cast in heated moulds. Even this modified programme would entail 1,944 different mixtures. How many physical properties to be considered could be arranged, but cooling curves would be useful. The melting and casting temperatures are vital and could be fixed at 10 per cent. and 5 per cent. respectively, above Dr. Hanson's liquidus curve for the corresponding silicon content.

The question of how the increases of each element are to be made, is important. The addition of high-percentage ferro-silicon or ferro-manganese direct to the melt under investigation is too drastic, and masks any lag or inertia of dissociation usually found. Adamson before the Iron and Steel Institute stated, "It was well known that the addition of high-grade ferro-silicon to white or mottled iron produces, and in close grey iron retains, the graphite in its most finely-divided state, and thus gives a much closer-grained iron than if the same silicon content were obtained from melting a high-silicon pig-iron." The author's air-furnace practice confirms this, viz.:—That for the same depth of chill from ladle sample, the silicon content is often four points higher if softening of bath has been made with ferro-silicon instead of silicon pig.

The same thing applies if the manganese is increased by additions down the spout, to cupola metal. Campion says, "The same results were not attained by additions of manganese down the spout." This also confirms personal experience over a number of years.

A loss of sulphur is obtained by adding manganese down the spout if the metal is held some time, but much loss in the ladle is never found even if the Mn to S ratio is higher, as charged. There was about a 10 per cent. loss of chrome when charged into the furnace as ferro-chrome, but on remelting the resultant metal in the cupola, no further loss took place.

These examples could be multiplied. Homma, using a 0.08 per cent. silicon Swedish pig, on drastically lifting the silicon to 1.98 per cent., found that this metal always gave a deeper chill and hardness (as much as 50 per cent.) than another iron that had not been so drastically treated, although the former, as used, was higher in both carbon and silicon, viz.:—3.75 per cent. carbon and 1.98 per cent. silicon in the first case, whilst the latter had only 3.48 per cent. carbon and 1.67 per cent. silicon.

The best method to make additions of any one element to an investigation was the one used by Dr. Hanson, where from the standard base metal he made a special alloy containing fairly large percentages of the element, say, 10 per cent. in the case of Si, Mn and P, with one per cent. for sulphur. With carbon, the difficulty would be to obtain even the 6.8 per cent. found in Dr. Hanson's case, but it might be possible to reach 4.5 per cent. carbon without unduly oxidising the silicon and manganese in the base of the metal. Then a 50-50 mix would give you the highest carbon required in the investigation. Roughly, 10 per cent. of the other alloys containing silicon, manganese, phosphorus or sulphur as the case might be, would give the maximum required. Additions made in this manner would allow for the usual reactions found in ordinary work. The remaining points are equally important, viz.:—Fix the size or sizes of the test pieces and the size of the box in which the test pieces are to be moulded and cast. If cooling curves of the sand are to be taken, the position of the end of the pyrometer in relation to the casting is to be given.

Investigations of Effect of Size of Bar.

With a 1.2 inch bar it is possible to obtain an all-pearlitic structure with widely varying total carbon and silicon, and even with different sized bars as shown by Beeny's paper (FOUNDRY TRADE JOURNAL, April 24, 1924), which illustrates this point. He used three mixtures of the analyses given in Table XI.

TABLE XI.—*Compositions Used by Beeny.*

Total carbon.	Combined carbon.	Si	Mn	S	P
3.38	0.65	2.30	0.51	0.08	1.0
3.56	0.83	1.39	0.55	0.11	0.86
3.54	0.84	1.13	0.53	0.115	1.0

From each analysis he cast bars $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, 1 and $1\frac{1}{4}$ inches in diameter in one box, all top run from the same runner, yet all these bars, with the exception of the $\frac{1}{2}$ inch from the last mixture, showed an all-pearlitic structure right across the bars. An examination of the microphotos shows a wide difference in both the pearlite and graphite condition. Maurer's results* confirm.

Maurer's Results Confirm Beeny's Results.

Take Maurer's No. 66 with TC + Si = 4.46 per cent. and No. 98 with TC + Si = 5.25 per cent., both are all-pearlitic: examine photos 42, 42A, 42B, on page 1,811, all three again show an all-pearlitic structure, but again a coarsening of graphite and pearlite due to (*a*) mould being heated to 250 deg. C., and (*b*) to 450 deg. C.

Some light is thrown on the subject by a Paper by Dr. Klingenstein. A chart is given showing the relation between physical properties to bar size and composition. From the diagram it is gathered that when using two sizes of bars cast from the same mixture, with 6.7 per cent. total carbon and silicon, the 20 millimetre diagram bar gave 4.75 tons transverse more than the 30 millimetre bar; with total carbon and silicon 5.4 per cent. the 30 millimetre bar broke at the original figure of the small bar, but the latter was still the 4.75 tons stronger. But with total carbon and silicon at 4.8 per cent., both bars broke at approximately the same and highest result attained.

Bolton found the larger bar much more sensitive to small variations, hence it would be best to try out both the new B.E.S.A. bars, $\frac{1}{2}$ in. and 2.2 ins. diameter. This may add to the difficulty of the proposition with crucible melting, but with the known lack of homogeneity in cast iron, no other course is advisable.

The size of the moulding box, number of bars per box, and that the sand be dried is of importance if comparable results are to be obtained. Take only three recent examples, Bolton, Maurer, and Hamasumi. In the first two there are given a heating and cooling curve of the sand in the box. Bolton also shows the cooling curve of the bar on the same graph. Bolton's bars would be made in accordance with the American standard, viz., two $1\frac{1}{4}$-in. diameter bars cast in a box approximately 10 ins. square, top run and made in dry sand. The heating curve of the sand shows a quick rise to 112 deg C., an arrest while water in combination is driven off and the sand attained its highest temperature of 338 deg. C., after 330 mins. The temperature of the bars had by that time dropped to 676 deg. C.

Maurer cast three 1.2-in. bars in a core only $4\frac{3}{4}$ ins. in diameter. This mould attained its highest temperature of 340 deg. C. in 30 mins. and then steadily dropped. The difference in time is accounted for by the difference in method. All three of Maurer's bars were within $\frac{3}{4}$ in. from the outer edge of the mould and only $2\frac{1}{8}$ in. centres radially, so the mould would heat up much quicker and also dissipate its heat quicker, due to the small size of the mould.

A comparison can also be drawn between the conclusion of Bolton and Hamasumi. The latter states that it took approximately $5\frac{1}{2}$ minutes for his $1\frac{1}{4}$-in. bar to cool from the eutectic arrest point to 900 deg. C. Bolton took approximately 40 mins. for his bars to do the same. Here, again, the difference in procedure will account for the large variation. Hamasumi used a box 8 ins. square, cast green sand and one bar in a box.

These large variations in cooling rate must have some influence on the structure of the bar, and only shows the futility of comparisons unless some well-defined plan is generally agreed upon.

Summary of Part I.

The author had three definite ideas in producing it:—(1) To show the critics that the problem was not the simple one their criticism implied; (2) that whilst the method of approach from a pure iron base was probably the best for steel, and even for cast iron in the first stages, no serious advance has been made along these lines since 1913, and the time has arrived for tackling the full problem; (3) a definite scheme is suggested. It may be crude, but would at least form a basis for discussion and improvement.

PART II.

The first part has dealt somewhat hurriedly with the theoretical side. But there is a much more serious issue that all practical founders must face if we are to regain lost ground, that is, the improvement and reliability of the material generally. Every times a casting goes out that is not right and without the knowledge of the buyer, the seller not only penalises himself, but lets down the whole trade, and adds to the lack of confidence in the material. We have been spending considerable time studying the technical reports of the British Engine, Boiler & Electric Insurance Company for the last twelve years. Too much praise cannot be given to these carefully prepared reports. Examples of various types of failures are given, together with the cause, with a view to avoiding a recurrence in the future. So far as the steel side is concerned, the writer displays a thorough knowledge of his subject. The various micros, tests, and sketches prove this. But with

* A Paper presented to the Philadelphia meeting of the American Foundrymen's Association, and to the Sheffield Branch of the Institute of British Foundrymen. The author is the well-known British Foundry consultant.

Von Ed. Maurer und P. Holtzhaussen, "Das Gusseisendiagramm von Maurer bei verschiedenen Abkuhlungsgeschwindigkeiten," "Stahl und Eisen," Oct., 1927 pp. 1805-1812.

cast iron it is evident the author is not too conversant, and there appears on the surface an impression that cast iron is an unreliable material, and the sooner it is replaced the better. No analyses are given and only one set of test bars, and not a single micro. With some of his conclusions one can hardly agree. To quote one, No. 2,458, April 3, 1917, "Killed, injured. Cast iron heated oven. Composed of two hollow rectangular tables. The shelves were 2—11 × 1—8 × 3 ins. overall externally. The top and bottom plates, which averaged ⅜ in. thick, were strengthened by two rows of stays 1¼ in. diameter, cast in position, pitched about 6 in. centres. Steam at 120 lbs. pressure was admitted by a ½-in. pipe into the upper shelf. This casting was tested to 240 lbs." Yet after eleven years with steam daily at 120 lbs. it was stated: "That the *strains produced in the process of casting* had in the course of years resulted in the development of defects leading to the ultimate failure of the stays." Testing to 240 lbs. was more likely to cause incipient fracture, but a more likely cause would be the "breaking" action over 11 years expansion and contraction. The above is not written in any carping spirit. It is recognised to the full, that it is equally to the advantage of the insurance company and the ironfounder to reach the correct reason for failure, so as to avoid it in the future. That much fuller information would be appreciated goes without saying. Several of the failures in oil and gas engines would form an excellent basis for discussion at the various foundry technical meetings, were the reports given more in detail, such as analyses, micros, and tests. Such discussions would be helpful to all parties concerned.

While it is not possible to comment on the hundreds of reports given there is some consolation to be derived from the fact that, though there were numerous cases of moulding faults, there were few failures due to metal alone in the higher grade machines, not near so many as steel, with wrong heat treatment and slag inclusions.

For instance, if we take turbo-generators and other electrical machinery, out of over 100 reports there are only three relating to cast iron. The first was due to wrong design, where a turbine built in 1912 had two stiffening ribs on the outside. These formed a source of weakness, owing to the slight "breaking" of the casting, and commenced to crack on the outer edge. When cut away, the cracking stopped. In 1926 a report is given of a 1500 K.V.A. impulse type turbo-generator, working at a pressure of 160 lbs. pressure and a superheat of 300 deg. C. After five years cracks were noticed at the high pressure end. The writer states, "cast iron is at no time the most suitable material for use with steam at high temperatures and less with a complicated casting." Yet the fact remains there are many turbines working at equal temperatures, with no sign of failure. Would it not have been better to get down to the root cause?

Steam Engines and Pumps.

In this section much of the trouble was due to faulty design, and neglect in working. Only two definite charges were made against cast iron as supplied. (1) Cracked cylinder, after running 18 years "The trouble owed its origin to stresses set up when the part was cast." (2) A broken valve seat, part of which found its way into the cylinder and caused damage. "The fact that cast iron is an unsuitable metal for superheat steam is well known; the present case, however, illustrates a more serious danger than the mere failure of a cast iron part, which may result from the injudicious use of that metal." Both of these conclusions are more than debatable, and, considering the thousands of similar engines that have been running many years, one would have liked some more reasoned explanation than a mere statement, especially in view of the fact that there are twice as many failures of steel parts, a number of which are due to defective material. Yet we find no wholesale condemnation as in cast iron.

Gas and Oil Engines.

The failures in this section are more serious from the founders' point of view. Fractured breech ends, cylinder jackets, and water jackets are far too frequent. While quite three-fourths are due to the use of unsuitable cooling water scaling up the water spaces, causing overheating, and others due to bad design, there are sufficient left to call for serious research both metallurgically and from the point of design. That in many cases failure is due to wrong analyses, goes without saying, else how is it so many stand up to the variation in expansion between the inner and outer casings? This is a case where test bars are almost useless and where the composition must be controlled to suit the design of the cylinder, especially where there are narrow jacket cores. An example was given in "The Foundry" last year, where in a 25-ton jacket cylinder, owing to the heat retaining qualities of a thin jacket core, the combined carbon was reduced to 0.05 per cent. with a Brinell of 89, while a bush cast from a similar metal showed 0.55 per cent. combined carbon and a Brinell of 138. Discussing Fig. 2, which was temporarily mended after cracking owing to expansion stresses during working, the writer states: "Even with a carefully considered design, the metal is only able to withstand the stresses imposed on it, when the greatest care has been exercised during its casting, special attention being necessary in fixing its composition and in carrying out the mixing and pouring." With this dictum we are in perfect agreement, and from the fact that there are thousands of gas and oil engines at work, goes to prove, that difficult as the job may be, a fair amount of success is attained, and it is shown how vital it is that the true cause of the failures should be known. Complete analyses, micros, and tests should be taken and investigated as in steel.

Lifts and Cranes.

No failures in this section due entirely to cast iron.

Explosions.

This section is by far the most serious from the founders' standpoint, because of the number of accidents causing loss of life and injury that occurred due to material that had no right to have been sent out. There were twenty-four cases where pipes, valves, steam chests, etc., were out of section, causing a loss of fourteen killed and seventeen injured. "Rectangular chest 5/16 to ½ inch one side, 1 in. on the other," "C.I. tank should be ¾ in., varied from 3/16 in. to ⅝ in.," "C.I. pipe ⅝ in. one side, 1 3/16 in. other," "Main stop valve 22/32 in. one side, 1 3/16 in. other," are a few of the worst examples. There is no excuse for failures of this type and, although the casting stood up to its work for a good number of years, the continual stresses set up by the variation in heating and cooling of the thick and thin side, must eventually lead to failure.

Another phase that comes out clearly from these reports is the thoughtlessness of works engineers with regard to both design and the pressures they put on to some castings. The severe screwing up of flanges with only a narrow packing between, the replacement of a few cast-iron pipes with steel ones in a long range of pipes, with no arrangement for the extra expansion due to the double expansion of steel; taking a valve or tank from a low pressure main and inserting one with a much higher pressure, and many more matters of this sort. More than half the failures were due to water hammer, and this was a fruitful source of failure in both steel and copper pipes.

In conclusion, the author would ask the engineer to consider his side of these useful reports. He should place his orders for any castings under pressure with a reliable firm which had metallurgical control, insist on a rigid inspection; pay a fair price to cover this inspection, and also the extra control in the foundry. The founder is asked that as he values his trade, he inspect his product carefully before leaving the works, and see that a suitable composition is used for all pressure work, even pipes. If a standard mixture is not suitable, make a special charge or two, and if this is against production, either obtain a price to cover the extra expense or refuse the order. None of us likes to do this, but if founders are to regain confidence they must face the difficulties. To the author of these very excellent reports it is again urged that he gives the fullest information. The research committees of the American Foundrymen's Association would render aid for any failures of American material, of which one or two have been noticed, while it is well known that the British Cast Iron Research Association would be more than willing to give assistance with British work.

Institute of British Foundrymen.

Twenty-Fifth Annual Convention.

(*Continued from page* 453.)

Junior Sections.

Last, but not least, may I make a brief reference to the Junior Sections? We now have five of these, and as far as I can gather from reports they are all in a flourishing condition. It is a very happy thought of the anonymous donor to offer Buchanan medals for competition amongst the members of our Junior Branches, and I am particularly delighted that Robert Buchanan's memory should be commemorated in such a happy way. We all remember his genial personality and his kindly manner, he had a deep knowledge of the craft, and was always ready to give advice and assistance. He was our first President (1904-1905), he maintained his interest in the Institute right up to the end, and I am sure that no more suitable way can be imagined for perpetuating the memory of this lovable man.

I am entering upon my year of office full of hope and confidence that our Institute will continue to maintain progress, not only in numbers, but also in status, and I am sure that I can rely upon the support of every member in doing his best to make the present year one of real progress, so that when our friends from overseas are present at the next Convention they will find an Institute second to none in this country of ours.

Vote of Thanks to the President.

MR. JOHN T. GOODWIN (Past-President), in proposing a very hearty vote of thanks to the President for his excellent Presidential Address, remarked that never in his experience of the Institute had he heard an address which so clearly conveyed to them the enormous work that the Institute was doing, and which showed such a thorough grasp as their President had of the work that should be done.

MR. WESLEY LAMBERT formally seconded.

The vote of thanks was carried with enthusiasm.

The PRESIDENT briefly responded.

Technical Exhibits at International Conference.

MR. WESLEY LAMBERT reminded them that the President had mentioned in his Address that a Technical Exhibition would be held at the time of the International Conference in London. At the former exhibition held in London they had had a Technical Exhibition, and he had the honour of being the Chairman of the Committee which had arranged that. It was proposed to do something on an even larger scale than had been arranged on that occasion. Judging from the numbers of letters he had received, that portion of the Exhibition appealed very much indeed to the members of the Institute. He was hoping they would all give very deep consideration to the Technical Exhibit, so that when they were called upon, they would be in a position to tell them what they were prepared to offer. Those who attended the London Exhibition would remember the class of exhibit that he was referring to. They wanted particularly typical castings and typical failures, so that one had an opportunity of seeing the difficulties that those engaged in every section of the industry were up against. In that way they were in a much better position to make comments at discussions and to educate themselves. They hoped that the Technical Exhibit at the coming Foundry Trade Exhibition would be a very successful one, and on a fine scale.

The PRESIDENT supported Mr. Lambert in his request, but he expected everyone would have much less difficulty in supplying Mr. Lambert and his Committee with typical failures than with typical castings. (Laughter.)

The reading and discussion of Papers was then proceeded with.

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Trade Talk.

MR. JAMES WING, chairman of Messrs. Leadbeater and Scott, Limited, steel manufacturers, Sheffield, died recently at the age of 58 years.

MESSRS. WILLIAM DOXFORD & SONS, LIMITED, Sunderland, have booked an order from the Moor Line, Limited, for a motorship of 8,000 tons.

DISMANTLING of the Harrington ironworks, belonging to the United Steel Companies, Limited, which were closed down in 1921, has commenced.

THE VULCAN FOUNDRY, LIMITED, Newton-le-Willows, and Messrs. Nasmyth, Wilson and Company, Limited, Manchester, are to build 21 and 18 locomotives, respectively, for the Indian State Railways.

AN ORDER FOR a passenger and cargo steamer has been placed by Messrs. Huddart Parker, Limited, Melbourne, with Messrs. Harland and Wolff, Limited. The vessel will be constructed at the builders' Govan yard.

THE No. 4 MILL at the Upper Works of the Ebbw Vale Steel, Iron and Coal Company, Limited, has been restarted after a long period of idleness. Three shifts will be worked at the mill for the first time, providing employment for 250 men.

AN EXPLOSION OCCURRED from a large blast main in the vicinity of the turbo house at the Thorncliffe Ironworks of Messrs. Newton, Chambers & Company, Limited, recently. Two large valves were lifted out of position, causing considerable damage to the building.

TO COPE WITH the steadily-increasing growth of business through the ports on the West Coast of England, and to allow for future expansion, the L.M.S. Railway are spending some £250,000 on a scheme to improve the ports of Garston and Fleetwood (Wyre Docks).

AN EXTRAORDINARY GENERAL MEETING of Messrs. W. and T. Avery, Limited, at Birmingham, on Friday last, unanimously decided to capitalise £225,486 of the reserve fund by a distribution among ordinary shareholders of one new ordinary share of £1, credited as fully paid up, for every two ordinary shares now held.

MESSRS. GREENWOOD & BAILEY, LIMITED, Albion Works, Leeds, inform us that the selling organisation for their industrial electric trucks, tractors and locos., recently in the hands of Messrs. W. Goodyear & Sons, Limited, of Dudley, is now being handled entirely by themselves, and that they are no longer associated in any way with the Dudley firm.

THREE NEW FURNACES have been erected and put into operation by the Stanton Ironworks Company, Limited, near Nottingham. Each will have an output of about 1,000 tons of pig-iron per week. It is proposed, when the time is considered favourable, to erect two additional furnaces, and when these are completed the nine furnaces, which for many years have existed at Stanton at the old and new works, will be replaced by five new furnaces.

DURING THE DISMANTLING of the West Auckland Colliery of Messrs. Bolckow, Vaughan & Company, Limited, there was brought to light an interesting link with the early days of engineering. It has been revealed that the winding engine at the colliery, which was installed in 1835 or 1836, and was used continuously up to the closing down of the colliery two years ago, was made by Timothy Hackworth at his Soho Works, Shildon. With the expiry of the lease of the colliery, the engine now becomes the property of Sir Timothy Eden, Bt., but it is hoped that it will find a permanent home among other relics of the Stephenson and Hackworth era.

IN A LETTER to the Press, Mr. W. T. Bell, chairman and managing director of Messrs. Robey & Company, Limited, engineers, of Lincoln, describes the scheme of co-operation which is in force between the Company and their employees. Representatives of the directors and works management, and one representative of the workmen from each of the 22 works departments, have been formed into what is known as "Robey's Board of Co-operation." The objects of the board are the making of suggestions with regard to, and the discussion of all matters relating to, workshop methods of production, progress of manufacture, and improvement in inter-departmental relations with a view to improved relations between the management and the men. The men's section must not assume the duties of shop stewards, or take any action likely to cause friction between the board and the trade societies. Complaints must not be brought forward with respect to matters affecting shop management, unless the matter has, in the first place, been taken to the respective foreman by the complaining party. The meetings take place out of working hours, and no man gets paid anything whatever for his attendance. The ideas put forward by the workmen's representatives, it is stated, have been sound and helpful, and in the majority of instances have been adopted and put into immediate effect.

Personal Paragraphs.

MAJOR JOHN COLVILLE, a director of Messrs. David Colville & Sons, Limited, Glasgow, has been chosen as prospective Unionist candidate for North Midlothian.

MR. F. J. HARLOW, Principal of the Wigan Mining and Technical College, has been appointed Principal of the Chelsea Polytechnic, London.

SIR JOHN FIELD BEALE has been elected chairman of Messrs. Guest, Keen and Nettlefolds, Limited, in succession to the late Lord Buckland, and Sir J. Gomer Berry, Bt., has been elected a director of the company. Sir John Beale has had a seat on the board of Messrs. Guest, Keen and Nettlefolds since 1917. In addition, he is a director of the London Midland and Scottish Railway, and of Messrs. John Lysaght, Limited, and chairman of the Universal Grinding Wheel Company, Limited, and the Orconera Iron Ore Company, Limited. Sir J. Gomer Berry is also a director of Messrs. John Lysaght, Limited.

Will.

SHAW, B., head of Messrs. Bennett Shaw & Son, brassfounders, Halifax £2,675

New Companies.

Burn Transmissions, Limited.—Capital £25,000. Smelters, etc. Directors: L. Burn and G. H. Alexander. Solicitors: Stokes & Stokes, 32, Bishopsgate, London, E.C.2.

Taylor Stoker Company, Limited.—Capital £40,000. Ironfounders, etc. Provisional directors: F. W. Gurney, L. A. Ellwood and D. J. Hall, all of 18, Austin Friars, London, E.C.2.

New Propeller for R.M.S. "Mauretania."

The propeller illustrated below was cast and finished at the Charlton Foundries of Messrs. J. Stone and Company, Limited, and made of Stone's Turbiston bronze. It is one of the heaviest bronze propellers made in this country, the casting weight being 31 tons, while the finished weight is 18¼ tons. The diameter is 16 ft. 9 in. and the propeller when fitted will revolve at the rate of 200 revs. per minute, which means that each tip travels at the rate of two miles per minute through the water. It has cost over £3,000.

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It weighed 31 tons as cast, and 18¼ when finished. It is 16 ft. 9 ins. diam. and is made from Turbiston bronze in the Charlton Foundries of Messrs. J. Stone & Company, Limited.

Contracts Open.

Oulton-with-Woodlesford, June 26.—About 90 tons of 7-in. and 6-in. cast-iron socket pipes and specials, and sluices, valves, hydrants, pressure relief valve, surface boxes, etc., for the Hunslet Rural District Council. Messrs. C. H. Marriott, Son & Shaw, Church Street Chambers, Dewsbury. (Fee £1 1s., returnable.)

Johannesburg, July 5.—Pumping plant, for the South African Railways and Harbours. The Department of Overseas Trade. (Reference A.X. 6357.)

Safeguarding of Industries.

Mr. Baldwin received at the House of Commons last week a deputation from the National Union of Manufacturers on the subject of the existing procedure in connection with the safeguarding of industries.

Mr. George Terrell, president of the National Union, who opened the discussion, called the attention of the Prime Minister to the difficulties, the expense, and the uncertainty of the existing safeguarding procedure, which had shown comparatively meagre results. Numbers of industries exposed to unfair foreign competition had either failed to obtain committees of inquiry or, if given committees, had been unable to satisfy the onerous conditions in the White Paper. He asked the Prime Minister to substitute a simpler and more accessible procedure.

Sir Holberry Mensforth (managing director of Messrs. Bolckow, Vaughan & Company, Limited), a member of the executive council of the N.U.M., dwelt on the vital importance of a strong iron and steel industry from a defence point of view and as the foundation of our manufacturing position. British manufacturers were selling pig-iron to-day at a price no higher than in 1913 and steel at prices not more than 20 per cent. over 1913 prices, although the cost of services and material had gone up over 50 per cent. No iron and steel works in this country, however modern and efficiently run, owning its own minerals, could at present make any return on the capital invested in it. Safeguarding was needed until conditions on the Continent became stabilised, to enable the industry to subsist in this country, and to give it an opportunity of recovering from post-war difficulties.

Catalogues Received.

High Speed Steel; Heat Treatment. — Bulletin No. 40, issued by Automatic & Electric Furnaces, Limited, North Road, Holloway, London, N.7, is devoted to an article by Mr. A. R. Page on "High Speed Steel." We consider that this should be in the hands of every founder, as it contains just that amount of reliable information on the subject which should be possessed by all engaged in the foundry industries.

Shovels. The Hardy Patent Pick Company, Limited, of Sheffield, have sent us a four-page leaflet, which certainly carries a wealth of convincing testimonials as to the durability of their Miracle shovels, and no doubt amongst them some are from founders. We suggest that as this industry includes about 4,500 establishments it would be interesting to have a catalogue prepared dealing specifically with their needs. Though different kinds of foundry sands vary in their abrasive action, reasonably-accurate life-tests which would be generally applicable could be rendered available. An interesting offer is made to supply a dozen Miracle shovels at the same price as ordinary forged steel shovels of the pattern now used in any foundry in order that a practical comparison may be made.

Mine Tubs and Cages made of Duralumin.—Mine tubs and cages are now made of duralumin by several firms in Germany. Owing to the light specific weight and high elastic limit of this metal, its other mechanical properties and its resistance to corrosion, it is possible to keep down the dead weight of the tubs and cages without reducing their safety. The elastic limit of duralumin is given as 30 to 34 kg. per sq. mm. (19.0 to 21.6 tons per sq. in.) and the tensile test as 44 to 48 kg. per sq. mm. (28.0 to 30.5 tons per sq. in.) with 14 to 18 per cent. extension. Its weight is about one-third of that of mild steel.

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—Following the usual rule at this period of the year, business in the Cleveland iron market has slackened down in view of the customary half-yearly stocktaking at works, and a general disinclination on the part of consumers to undertake fresh commitments at the present level of prices is still a restraining factor in the negotiation of fresh contracts. Sales, both for home consumption and export demands, are consequently on a restricted scale, and, although successful in shutting foreign iron out of the Scottish market, the Cleveland makers are beginning to find Midland iron a serious competitor. Rail charges from the blast furnaces to the Lincolnshire ports are heavy, but even so Northants and Lincolnshire iron can compete with Cleveland in Scotland, and is doing so with a fair measure of success. Prices, however, are unchanged as follow:—No. 1 Cleveland foundry iron, 68s. 6d.; No. 3 G.M.B., 66s.; No. 4 foundry, 65s.; No. 4 forge, 64s. 6d. per ton.

The position in the East Coast hematite market indicates little hope of an early improvement in the extreme depression now existent, and limited though the output at furnaces may be, it exceeds the demand, and producers are selling every ton of iron they make at a loss of several shillings per ton. Recently an effort was made to stabilise the price of East Coast mixed numbers at 70s., and makers continued to quote that figure whilst selling at 69s. But a buyer not particular as to brand would have no difficulty in covering his needs at 68s. On the North-West Coast there is only a limited demand for Bessemer mixed numbers, with 70s. per ton at works quoted as the current figure.

LANCASHIRE.—Though by no means normally active, some slight improvement in demand has been experienced in the local markets for foundry pig, but this has not been very pronounced so far, and not all sellers have had the good fortune to share in it, for there are some who still complain of lack of business. Prices of Derbyshire and Staffordshire irons have, apparently, by no means yet reached stabilisation, for occasionally one hears of offers well below the 70s. per ton level which Midland makers are quoting for small parcels, including delivery Manchester or equal distance.

THE MIDLANDS.—At Birmingham and throughout the Black Country in general the demand for foundry pig continues much below the normal scale, with prices somewhat irregular. Derbyshire No. 3 is on offer at from 60s. to 61s. 6d., Northants. 56s. to 57s., and North Staffordshire 60s. to 61s. 6d., all at furnaces, with Lincolnshire No. 3 quoted at 72s. 6d. delivered works.

SCOTLAND.—The Scotch pig-iron market continues very slow, and with the annual holidays coming on next month, there is no immediate prospect of a change for the better. Stocks are accumulating, and as the works will probably be closed next month for a longer period than usual, these will be further augmented. The nominal quotation for No. 3 foundry remains at 70s. at the furnaces, although one or two makers are inclined to advance their price.

Finished Iron.

In the Black Country area only the works making marked bars are at all actively engaged. Even they cannot keep fully occupied, but maintain the figure of £12 per ton at works for this grade. There is no sign at all of any improvement in the demand for crown and cheaper irons, and the Staffordshire makers are finding keen figures coming through from Lancashire and Derbyshire for this class of material. Quotations at present vary from £9 to £9 15s. per ton, and about £8 15s. for nut and bolt quality. The local works cannot get much of the business for the latter trade because of foreign competition. This is still rife, and the Belgian No. 3 product is being offered freely at figures between £6 12s. 6d. and £6 15s. per ton, delivered works in the Darlaston area.

Steel.

In the market for British material prices have become firmer, although no definite advance has been made, while the Continental steelmakers are holding their quotations at around the levels to which they recently advanced. At Sheffield the market is moderately active. Acid billet demand is fairly good, but basic qualities are rather dull. In both the prices are unchanged. Steel bars, strip and wire command little attention. The production of open-hearth steel is on a smaller basis, and crucible steel is less active. On the other hand, the output of stainless steel continues to expand, with good demand for both home and export. In the tinplate market inquiries are still coming in fairly well from all quarters. Current quotations for coke tinplates may be called 18s. 6d. to 19s. basis, net cash, f.o.b. Wales.

Scrap.

The general slackness now prevailing throughout the consuming industries has naturally had an adverse effect upon the scrap metal trade, which, as a whole, is dull and somewhat depressed. On the North-East Coast inactive conditions at the heavy foundries limit the consumption of heavy cast-iron, but sellers refuse to cut prices any further, and quotations are maintained at 62s. per ton for ordinary quality and 66s. for machinery quality in handy pieces. In the Midlands there is a slightly improved demand for cast-iron scrap, 65s. to 67s. 6d. per ton delivered being offered for heavy machinery scrap in cupola sizes and 55s. per ton for light cast-iron scrap. In Scotland cast-iron scrap is in very poor demand, and it is difficult even to obtain 67s. 6d. for first-quality machinery cast-iron material, suitable for foundries. Ordinary cast-iron scrap is at 61s. 3d. to 62s. 6d. per ton, and steelworks cast-iron scrap at 60s. Old cast-iron railway chairs are still being quoted at 65s. to 67s. 6d., and light cast-iron scrap is 56s. 3d. to 57s. 6d. The above prices are all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—The position in the market for cash warrant copper is generally well maintained, although there is some slight tendency for prices to decline. The forward outlook is, however, very uncertain. A return of speculative interest might well, under existing conditions, bring about an advance in quotations, although an alternative possibility is that the next official statistics will reveal an increase in world output and thus produce an easier tone. Stocks of refined metal in America continue to decline, but the figures are almost without effect, since speculative interest in this market is at a low ebb.

Closing quotations are:—

Cash.—Thursday, £64 to £64 1s. 3d.; Friday, £63 16s. 3d. to £63 17s. 6d.; Monday, £63 16s. 3d. to £63 17s. 6d.; Tuesday, £63 10s. to £63 11s. 3d.; Wednesday, £63 2s. 6d. to £63 3s. 9d.

Three Months.—Thursday, £63 18s. 9d. to £64; Friday, £63 15s. to £63 17s. 6d.; Monday, £63 15s. to £63 16s. 3d.; Tuesday, £63 10s. to £63 11s. 3d.; Wednesday, £63 2s. 6d. to £63 3s. 9d.

Tin.—End-of-the-week quotations for standard cash tin were again lower, making a decline of nearly £8 on the figures for the previous week. Sales in the East have continued steadily, while buyers generally, particularly in the United States and on the Continent, have showed a disposition to withhold orders. Stocks of the metal in New York are greater than they have been for some years, and the market over there is very weak. The present irregularity is due more to depressing operations on the market than to inherent weakness of the position.

Official closing prices:—

Cash.—Thursday, £217 5s. to £217 10s.; Friday, £221 to £221 5s.; Monday, £216 10s. to £216 15s.; Tuesday, £213 10s. to £213 15s.; Wednesday, £210 12s. 6d. to £210 17s. 6d.

Three Months.—Thursday, £215 10s. to £215 15s.; Friday, £218 12s. 6d. to £218 17s. 6d.; Monday, £213 15s. to £214; Tuesday, £210 15s. to £211; Wednesday, £208 10s. to £208 15s.

Spelter.—Conditions in the market for ordinary spelter continue quiet and uneventful, values having fluctuated within narrow limits, and the turnover has not been large. Consumptive purchases have been restricted in volume, and in view of this prices may be said to have held fairly well, as the assumption is that stocks in producers' hands must be increasing. There has been no sign, however, of excessive selling pressure on the market.

Daily quotations are:—

Ordinary.—Thursday, £25 13s. 9d.; Friday, £25 15s.; Monday, £25 10s.; Tuesday, £25 6s. 3d.; Wednesday, £25 7s. 6d.

Lead.—The market for soft foreign pig is without any change of importance. Continental consumers have continued to make purchases fairly freely, but buying on home account is not large, the assumption being that British users either have considerable stocks in hand or are holding back in the hope of depressing prices. It is stated that stocks of Spanish lead awaiting shipment are rather heavy, and there are again suggestions that producers in that country may attempt to enhance the level of prices by reducing output.

Closing prices:—

Soft Foreign (Prompt).—Thursday, £20 18s. 9d.; Friday, £20 18s. 9d.; Monday, £20 17s. 6d.; Tuesday, £20 12s. 6d.; Wednesday, £20 10s.

Activities of the Institute of Metals.

The Liverpool meeting of the Institute of Metals, to be held on September 4-7, is proving very attractive. Already over 200 members, including many from overseas—have indicated their intention of taking part in the meeting. The Papers to be presented include a valuable series dealing with the die-casting of alloys, as well as the Eighth Report to the Corrosion Research Committee. A "full-dress" discussion of corrosion problems will form a feature of the meeting. It is particularly appropriate that this discussion should take place in a maritime centre such as Liverpool. On the social side the gathering promises to be a pleasant one; a series of receptions, visits to places of interest and other functions is being arranged by the Local Reception Committee. On July 4 an election of members is taking place in connection with the Liverpool meeting, full particulars of which can be obtained from Mr. G. Shaw Scott, M.Sc., secretary, Institute of Metals, 14, Members' Mansions, Westminster, London, S.W.1.

Changes in Rail Rates affecting the Foundry Industry.

Effect of Classification Alterations.

BY J. W. PARKER, A.M.INST.T.

In securing lower rail rates, the two main factors are exceptional charges and a lower division in the classification book. In connection with the latter, a number of reductions have recently been conceded, some of which concern the foundry business. Crucibles, for instance, were previously in Class 16, but now they are dealt with as under:—

4 tons per truck	Class 13
Less	,, 15

In terms of money the saving consequent upon forwarding a wagon load of four tons for a 100-mile journey at standard rates amounts to 6s. 10d. per ton. Clay or plumbago crucibles have the possibility of a further saving when consigned at owner's risk, as the "c" reduction is applicable.

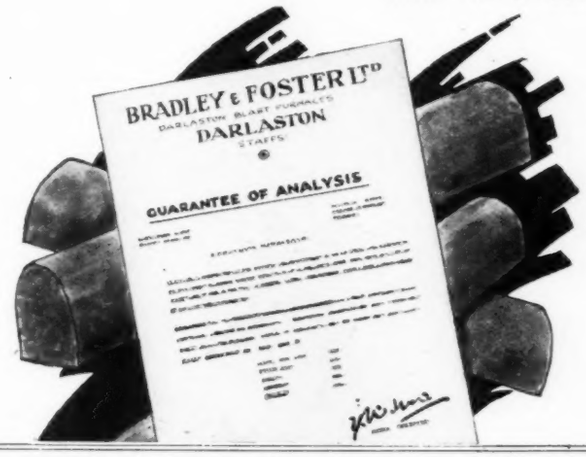
Unmachined castings have received favourable consideration. Those of iron or steel (light type) are reduced from Class 17 to 15 provided they are loaded to the extent of two tons per truck. Those castings of brass, bronze or copper, whilst retaining their classification, are now able to use any exceptional rates there may be for hardware.

Anti-friction white metals come down one class to 15, whilst furnaces for heating metals (without meters or instruments) are lowered also by one division to Class 14.

As is known, the standard rates applicable to the higher classes contain amounts for covering and uncovering, consequently when goods in the appropriate classes are forwarded in full truck loads without cover, some allowance should be made. The amount to be conceded has now been fixed as 3d. per ton for goods in Classes 7-10, 5d. in Classes 11-13, 6d. for 14-18, 10d. for 19, and 1s. for 20. Although the allowance may not average more than 2s. per truck, the accumulation of such little economies over a period will reach a substantial total well worth the trouble entailed in watching an apparently small point.

XUM

WHAT THE BRADLEY SERVICE MEANS TO THE FOUNDRYMAN. No. 6.



REFINED PIG IRON WITH INHERENT PROPERTIES.

Chemical composition plays an important part in determining the strength properties of cast iron, but composition alone will not explain why modern refined irons can be relied upon to give tests rarely, if ever, obtained with direct furnace pig iron.

> **"Modern refined pig irons are manufactured with consistent regularity which give tensile strengths of from 17 to 20 tons per square inch on test bars machined from the pig iron."**
>
> **J. E. Hurst — "High Grade Pig Iron," F.T.J., March 29, 1928.**

The Bradley range of refined pig irons gives consistently high tensile and transverse tests and possesses all those inherent properties which go to make sound, strong and perfect castings.

Bradley's

PIG IRON

"A QUALITY FOR EVERY REQUIREMENT"

Write or 'phone for particulars of the Bradley range of Refined Pig Irons. Immediate attention is given to all enquiries and the knowledge and long experience of Bradley's is at the disposal of all foundrymen.

Make full use of The Bradley Service

BRADLEY & FOSTER LTD BF **DARLASTON, STAFFS.**

WEEKLY PRICE CURRENT.

COPPER.

	£	s	d
Standard cash	63	2	6
Three months	63	2	6
Electrolytic	68	15	0
Tough	66	10	0
Best selected	66	15	0
Sheets	94	0	0
India	77	5	0
Wire bars	69	0	0
Do. June	69	0	0
Do. July	69	0	0
Ingot bars	69	0	0
H.C. Wire rods	73	10	0
Off. av. cash, May	62	11	9 9/11
Do. 3 mths., May	62	15	8 5/11
Do., Sttlmnt., May	62	11	8 5/11
Do., Electro, May	67	9	3 9/11
Do., B.S., May	65	18	0
Aver. spot price, copper, May	62	11	9 3/4
Do., Wire bars, May	67	14	3 1/2
Solid drawn tubes			13 1/2d.
Brazed tubes			13 1/2d.
Wire			10d.

BRASS.

Solid drawn tubes	11 1/2d.
Brazed tubes	13 1/2d.
Rods, drawn	10 1/2d.
Rods, extd. or rlld.	7 1/2d.
Sheets to 10 w.g.	10 1/2d.
Wire	9 1/2d.
Rolled metal	9 1/2d.
Yellow metal rods	7 1/2d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8 1/2d.

TIN.

	£	s	d
Standard cash	210	12	6
Three months	208	10	0
English	210	0	0
Bars	214	10	0
Straits	214	10	0
Australian	215	10	0
Eastern	215	5	0
Banca	Nominal		
Off. av. cash, May	230	19	3 3/11
Do., 3 mths., May	230	7	10 10/11
Do., Sttlmt., May	230	18	7 7/11
Aver. spot, May	230	19	3

SPELTER.

	£	s	d
Ordinary	25	7	6
Remelted	24	10	0
Hard	20	0	0
Electro 99.9	29	10	0
English	25	5	0
India	21	5	0
Zinc dust	33	0	0
Zinc ashes	8	0	0
Off. aver., May	25	18	6 11/20
Aver., spot, May	26	2	0 1/2

LEAD.

	£	s	d
Soft foreign ppt.	20	10	0
English	22	0	0
Off. average, May	20	12	11 5/11
Average spot, May	20	9	8

ZINC SHEETS, &c.

	£	s	d
Zinc sheets, English	33	15	0
Do. V.M. ex whf.	32	5	0
Rods	39	0	0
Boiler plates	29	10	0
Battery plates	31	5	0

ANTIMONY.

	£	s	d
Special brands, Eng.	59	10	0
Chinese	40	0	0
Crude	34	0	0

QUICKSILVER.

	£	s	d
Quicksilver	21	15	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s	d
Ferro-silicon—			
25%	8	0	0
45/50%	13	0	0
75%	20	10	0
Ferro-vanadium—			
35/40%	14/3 lb. Va.		
Ferro-molybdenum—			
70/75% c. free	4/7 lb. Mo.		
Ferro-titanium—			
23/25% carbonless	1/2 lb.		
Ferro-phosphorus, 20/25%	£18	2	6
Ferro-tungsten—			
80/85%, c. fr.	1/3½ lb.		
Tungsten metal powder—			
98/99%	1/7½ lb.		
Ferro-chrome—			
2/4% car.	£32	0	0
4/6% car.	£22	0	0
6/8% car.	£21	15	0
8/10% car.	£21	7	6
Ferro-chrome—			
Max. 2% car.	£34	0	0
Max. 1% car.	£39	0	0
Max. 0.70% car.	£45	2	6
70% carbonless	1/2 lb.		
Nickel—99% cubes or pellets	£175	0	0
Ferro-cobalt	9/3 lb.		
Aluminium 98/99%	£105	0	0
Metallic chromium—			
96/98%	2/8 lb.		
Ferro-manganese (net)—			
76/80%, loose	£13	10	0
76/80%, packed	£14	10	0
76/80%, export	£13	5	0
Metallic manganese—			
94/96%, carbonless	1/6 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	£	s	d
Finished bars, 14% tungsten	£0	2	3
Finished bars, 18% tungsten	£0	2	9

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 1/8 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ½ in.	3d. lb.
Do., under ¼ in. × ¼ in.	1/-lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

Scrap from high-speed tool steel—	
Scrap pieces	3d.
Turnings and swarf	1d.

Per lb. net, d/d steel makers' works.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Hvy. steel	3	7	6	to	3	10	0
Bundled steel and shrngs.	3	2	6	to	3	7	6
Mixed iron and steel	3	0	0	to	3	2	6
Heavy cast iron					3	0	0
Good machinery for foundries					3	5	0
Cleveland—							
Heavy steel					2	17	0
Steel turnings					2	8	6
Cast iron borings					2	3	0
Heavy forge					3	10	0
Bushelled scrap					3	2	6
Cast-iron scrap	3	2	0	to	3	6	0
Lancashire—							
Cast-iron scrap					3	5	0
Hvy. wrought					3	2	6
Steel turnings					2	2	6

London—Merchants' buying prices delivered yard.

	£	s	d
Copper (clean)	53	0	0
Brass	38	0	0
Lead (less usual draft)	18	10	0
Tea lead	16	10	0
Zinc	16	10	0
New aluminium cuttings	70	0	0
Braziery copper	48	0	0
Gunmetal	49	0	0
Hollow pewter	160	0	0
Shaped black pewter	115	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	68/6
Foundry No. 3	66/-
Foundry No. 4	65/-
Forge No. 4	64/6
Hematite No. 1	69/6
Hematite M/Nos.	69/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	80/-
,, d/d Birm.	86/6
Midlands—	
Staffs. common*	67/6
,, No. 4 forge	57/6
,, No. 3 fdry.	62/-
Shrops. basic	—
,, Cold blast, ord.*	—
,, ,, roll iron*	—
* d/d Birmingham.	
Northants forge	52/6
,, fdry. No. 3	56/6
Derbyshire forge	58/-
,, fdry. No. 3	63/-
,, basic	—
Scotland—	
Foundry No. 1	75/-
,, No. 3	70/-
Hem. M/Nos.	74/-
Sheffield (d/d district)—	
Derby forge	63/6
,, fdry. No. 3	66/6
Lincs. forge	66/6
,, fdry. No. 3	67/-
E.C. hematite	81/6
W.C. hematite	85/6
Lincs. (at furnaces)—	
Forge No. 4	62/-
Foundry No. 3	62/6
Basic	60/6
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3	70/-
Northants foundry No. 3	—
Dalzell, No. 3(special)	100/- to 102/6
Summerlee, No. 3	86/- to 87/6
Glengarnock, No. 3	86/- to 87/6
Gartsherrie, No. 3	86/- to 87/6
Monkland, No. 3	—
Shotts, No. 3	86/- to 87/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.) nom.	9	0	0	to	10	15	0
Nut and bolt iron					8	15	0
Hoops	11	10	0	to	12	0	0
Marked bars (Staffs.) f.o.t.					12	0	0
Gas strip					11	10	0
Bolts and nuts, ½ in. × 4 in.					15	0	0
Steel—							
Ship plates					8	7	6
Boiler plts.					10	10	0
Chequer plts.					10	12	6
Angles					7	17	6
Tees					8	17	6
Joists					7	17	6
Rounds and squares, 3 in. to 5½ in.					8	17	6
Rounds under 3 in. to ½ in. (Untested)					7	15	0
					and upwards		
Flats, over 5 in. wide and up					8	7	6
Flats, 5 in. to 1½ in.					7	17	6
Rails, heavy	8	2	6	to	8	10	0
Fishplates					12	10	0
Hoops (Staffs.)					10	0	0
Black sheets, 24g.					10	0	0
Galv. cor. shts., 24g.					13	7	6
Galv. fencing wire 8g. plain					12	10	0
Billets, soft	6	5	0	to	6	15	0
Billets, hard	7	2	6	to	7	12	6
Sheet bars					6	0	0
Tin bars					6	0	0

PHOSPHOR BRONZE.

	Per lb.	basis
Strip	1	2½
Sheet to 10 w.g.	1	3
Wire	1	3½
Rods	1	3
Tubes	1	3½
Castings	1	2

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	20.76
No. 2 foundry, Valley	16.75
No. 2 foundry, Birm.	16.00
Basic	17.11
Bessemer	18.76
Malleable	18.76
Grey forge	18.01
Ferro-mang. 80% d/d	105.00
O.-h. rails, h'y at mill	43.00
Bess billets	33.00
O.-h. billets	33.00
O.-h. sheet bars	34.00
Wire rods	42.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.85
Tank plates	1.85
Beams, etc.	1.85
Skelp, grooved steel	1.85
Skelp, sheared steel	1.85
Steel hoops	2.20
Sheets, black, No. 24	2.65
Sheets, galv., No. 24	3.50
Sheets, blue an'l'd., 9 and 10	2.00
Wire nails	2.55
Plain wire	2.50
Barbed wire, galv.	3.35
Tinplates, 100 lb. box	$5.25

COKE (at ovens).

Welsh foundry	—
,, furnace	22/-
Durham and North.	
,, foundry	14/6 to 15/-
,, furnace	14/-
Other Districts, foundry	—
,, ,, furnace (basis)	12/- to 13/-

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes	20×14	box	18/7½	
,,	28×20	,,	37/3	
,,	20×10	,,	27/3	
,,	18¾×14	,,	19/3	
C.W.	20×14	,,	17/3	
,,	28×20	,,	34/6	
,,	20×10	,,	22/-	
,,	18¾×14	,,	15/9	
Terneplates	28×20		34/- per box basis f.o.b.	

SWEDISH IRON.

Bars, hammered,	£17 10 0 to £18 10 0
Rolled Ord.	£15 0 0 to £15 10 0
Nail rods	£15 7 6 to £15 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£8 to £12
Pig-iron	£5 15 0 to £6 0 0

all f.o.b. Gothenburg.

TUBES AND FITTINGS.
Up to and incl. 6 in.

	Tubes.	*Fittings.*
Gas	67½%	50%
Water	63½%	45%
Steam	60%	40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
June 14 ..	64	0	0	inc.	1/3
,, 15 ..	63	16	3	dec.	3/9
,, 18 ..	63	16	3	No change	
,, 19 ..	63	10	0	dec.	6/3
,, 20 ..	63	2	6	,,	7/6

Electrolytic Copper.

	£	s.	d.		
June 14 ..	69	0	0	No change	
,, 15 ..	69	0	0	,, ,,	
,, 18 ..	69	0	0	,, ,,	
,, 19 ..	68	15	0	dec.	5/-
,, 20 ..	68	15	0	No change	

Standard Tin (cash).

	£	s.	d.		
June 14 ..	217	5	0	dec.	5/-
,, 15 ..	221	0	0	inc.	75/-
,, 18 ..	216	10	0	dec.	90/-
,, 19 ..	213	10	0	,,	60/-
,, 20 ..	210	12	6	,,	57/6

Tin (English ingots).

	£	s.	d.		
June 14 ..	216	7	6	dec.	12/6
,, 15 ..	220	0	0	inc.	72/6
,, 18 ..	215	10	0	dec.	90/-
,, 19 ..	212	10	0	,,	60/-
,, 20 ..	210	0	0	,,	50/-

Zinc Sheets (English)

	£	s.	d.		
June 14 ..	33	15	0	No change	
,, 15 ..	33	15	0	,, ,,	
,, 18 ..	33	15	0	,, ,,	
,, 19 ..	33	15	0	,, ,,	
,, 20 ..	33	15	0	,, ,,	

Spelter (ordinary).

	£	s.	d.		
June 14 ..	25	13	9	dec.	1/3
,, 15 ..	25	15	0	inc.	1/3
,, 18 ..	25	10	0	dec.	5/-
,, 19 ..	25	6	3	,,	3/9
,, 20 ..	25	7	6	inc.	1/3

Lead (English).

	£	s.	d.	
June 14 ..	22	10	0	No change
,, 15 ..	22	10	0	,, ,,
,, 18 ..	22	5	0	dec. 5/-
,, 19 ..	22	0	0	,, 5/-
,, 20 ..	22	0	0	No change

Exports of Iron Castings in May and the five months 1928, compared with May and the five months 1927.

	May, 1927.	May, 1928.	Five months, 1927.	Five months, 1928.	May, 1927.	May, 1928.	Five months, 1927.	Five months, 1928.
BUILDERS' CASTINGS—								
Stoves, Grates, etc., Cisterns, Baths, etc., and cooking and washing boilers:—	Tons.	Tons.	Tons.	Tons.	£	£	£	£
To Argentine Republic	174	160	761	706	6,296	8,068	27,688	29,494
,, British South Africa	417	222	1,318	1,530	14,143	8,812	46,930	53,997
,, ,, India	99	82	526	689	4,501	3,227	23,189	29,957
,, Australia	57	49	455	290	3,461	3,254	24,356	20,252
,, New Zealand	142	117	1,010	863	8,332	6,072	51,155	42,366
,, Other countries	879	737	3,550	3,811	43,536	35,105	180,465	175,184
Total	1,768	1,367	7,620	7,889	80,269	64,538	353,783	351,250
PIPES AND FITTINGS—CAST—								
To Argentine Republic	1,505	627	4,911	3,693	14,149	6,310	53,939	38,782
,, British South Africa	870	871	2,417	2,302	12,343	13,928	40,011	35,981
,, ,, India	646	563	2,849	4,277	9,174	7,663	41,586	53,403
,, Straits Settlements and Malay States	1,512	1,666	5,120	6,433	17,371	13,649	51,323	58,394
,, Ceylon	160	87	534	544	1,825	1,099	6,781	6,702
,, Australia	2,354	2,771	3,631	4,930	22,407	28,957	42,158	53,527
,, Other Countries	4,908	5,512	21,086	25,805	67,234	63,256	304,063	341,057
Total	11,955	12,097	40,548	47,984	144,503	134,862	539,861	587,846
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	500	376	2,099	1,958	19,440	14,027	80,205	72,377
,, Enamelled	53	66	303	340	5,494	5,783	29,297	29,951
CASTINGS, in the rough—								
Iron	72	88	497	467	3,181	3,737	18,646	18,814
Steel	86	44	353	227	3,804	2,441	16,737	10,890

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